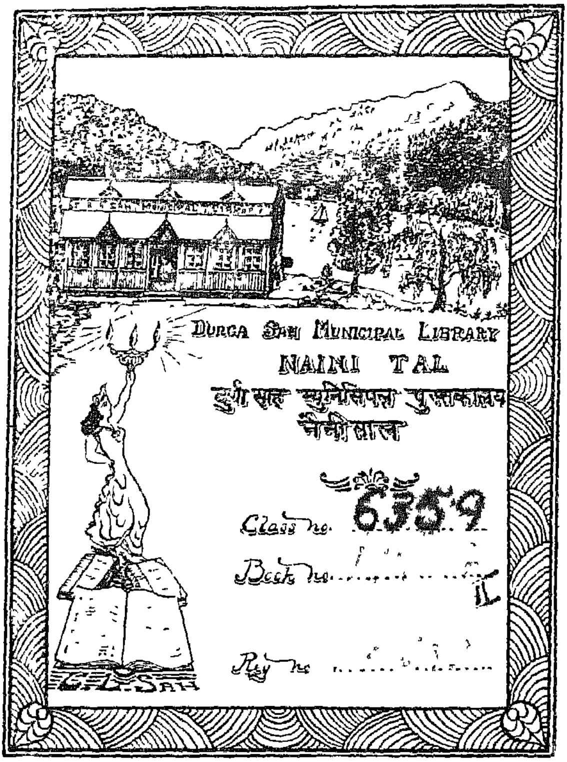

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Increasing the value of garden crops is today more important than ever. A well-managed greenhouse, making possible the provision of home grown supplies at the time when they are most expensive to buy, is a valuable means of bringing costs and returns more evenly into balance. In this issue authorities discuss at length the types of houses obtainable, alternative methods of heating and what to grow under glass. At the end of the book will be found a survey of the newest labour-saving garden aids and their uses and values in reducing the annual cost of upkeep to manageable proportions.

The section devoted to Heating is perhaps the most revealing which has yet been published, giving much valuable advice on latest developments. In the whole issue, the garden owner will find a wealth of information directed to the task of lightening his labours and increasing his rewards.

GARDENS AND GARDENING

VOL. 6

# GROWING UNDER GLASS
# GARDEN MAINTENANCE & EQUIPMENT

## GARDENS AND GARDENING
(*New Series*)

Vol. 1 Remaking and Rehabilitation
Vol. 2 Bulbs for all Seasons
Vol. 3 Hardy Plants
Vol. 4 Rock, Wall and Water
Vol. 5 Labour-saving Planning and Planting
Vol. 6 Growing under Glass

# GARDENS AND GARDENING

THE *STUDIO* GARDENING ANNUAL

VOLUME 6

## GROWING UNDER GLASS GARDEN MAINTENANCE AND EQUIPMENT

*EDITORS*

F. A. MERCER & ROY HAY

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# ACKNOWLEDGMENTS

*It is not without reason that garden lovers are frequently known as the gardening fraternity. Friendly people, they are all eager to share their knowledge and enthusiasm. This book is the result of eager co-operation between expert contributors and photographers, to whom we owe our grateful thanks.* F. A. M. and R. H.

# EDITORS' FOREWORD

IN VOLUME V OF *Gardens and Gardening* WE EXAMINED SOME OF THE PROBLEMS confronting those who wish to have a beautiful, productive garden in times when economic difficulties and the high cost of maintenance make their ambitions difficult to realize. We concerned ourselves in that issue mainly with the planning and planting of a garden so that its recurrent annual upkeep costs could be kept as low as possible. In that volume we made allowance for the gardener who is prepared to spend perhaps a little more than his neighbour, and who does not mind the extra care and trouble involved in having something just a little less streamlined than the most easily maintained garden must of necessity be. So it is with a similar thought in mind that we have approached the compilation of this present volume. We have tried to do several things. We have endeavoured to complete our survey of labour-saving ideas, this time going from the spheres of planning and planting to the more particular items of equipment which may be purchased to ease the gardener's burdens. We have also realized that during a period when enthusiasm for horticulture is increasing rapidly there are many people who are able and willing to devote time and money to the production of a certain proportion of luxury crops—flowers, fruits or vegetables—who wish to have these crops out of season and who accept the challenge to their skill as cultivators of such exciting plants as orchids, cacti, indoor chrysanthemums, carnations and the like. There is also the economic side of horticulture to be considered—so equipping the garden that it can be made to produce the crops that pay best. By this we mean that if our time, capital and labour are to be expended to the best advantage, they should be directed to producing crops which will be available for the gardener at a time when they would be most expensive to buy. Such crops usually entail the protection of glass or need to be pushed along with artificial heat if they are to mature at a worth-while season.

But in seeking to achieve any or all the objects dear to the heart of any gardener, it must always be remembered that there are usually several ways of going to work, and due consideration should be given to the most economical methods or equipment, such questions as first cost balanced against subsequent maintenance and so on. Let us examine the question of labour-saving machinery. Garden owners may desire several different things. Young men at the height of their business or professional career are usually short of time and they are probably willing to expend a certain amount of capital in order to accomplish the gardening tasks more quickly, giving themselves more time for the real skilled horticultural work which usually cannot be done by a machine. Then among the older generation there are many gardeners who have probably retired and therefore have all the time they wish on their hands, but are past the age when their physical strength permits them to do the arduous work of a garden. They are faced with the alternative of employing very often indifferent and highly expensive labour to do those gardening chores of which they used to make light in earlier years. When the pros and cons have been weighed up they, too, often decide to purchase a machine which will permit them to do their own work and thus avoid an endless vista of semi-skilled jobbing gardeners who often fail to appear on the appointed day or, when they do, insist on filling their time with tasks other than those the employer had intended them to undertake. And there is a third category of gardener—probably most of us come into it—those who wish to save money. The purchase of every piece of gardening equipment should be given the same careful thought and consideration as one would give to the purchase of a vacuum cleaner or of any other piece of equipment for the home. It is a wise policy to consult the large specialist firms who handle all makes of such machines as motor mowers, cultivators and the like. They usually have no axe to grind for a particular make, are skilled in sizing up the work a machine is expected to do, and able to advise on the correct choice of the machine. Where possible, it is also worth-while to attempt some form of costing. Let us take the case of the electric hedge trimmer. If one possesses 40 yards of hedge, 6 feet high, it has been computed that the initial cost of the machine, plus its maintenance costs over five years and an allowance for depreciation, would compare very favourably with the cost of cutting such a hedge by hand if one had to employ labour at current rates. So, too, one could work out the economics of growing plants in soil blocks made with a soil-block machine compared with the use of standard pots. It is not often possible to obtain clear-cut statistics such as one needs for these comparisons, but some kind of yard-stick can usually be worked out if one has the interest and patience, and an idea is thus gained about the wisdom of any given purchase.

It is fashionable in certain horticultural circles to decry the labour-saving tool or "gadget". Usually, any scornful rejection of such aids to gardening comes from the older school—those who have been used to the grand old days when abundant supplies of labour and fresh animal manure were used with abandon. The younger generation knows only too well that anything that tends to cut out the drudgery from gardening leaves more time and energy for those exciting tasks of propagation, hybridization, seed-raising, pruning, training and so on which are the very essence of gardening. Do not despise even the little things. When a gardener's time must be counted in minutes the little "string-ring" that slips on the finger and carries a protected knife—(see page 130) saves many minutes of fumbling for knives or scissors. Wire rings commonly used for tying sweet peas to stakes when they are grown on a cordon system are adaptable for many other gardening jobs of giving support to plants. Their use saves valuable hours in the course of the season.

Of course, it is very easy for a garden to become over-capitalized. When purchasing any labour-saving tool, due thought must be given to the amount of work it will be required to do. Nowadays there is much more sharing of tools being done by friends and neighbours. Sometimes a group of two or three buy a cultivator or some similar tool and share it. I have found, however, it usually works best if one member of the group buys, say, the automatic sieve, another the electric long-grass cutter, and a third a machine for driving in posts. Each remains responsible for his own machine and gives it more care and attention than it would get from three joint owners. But again there are some tools which it is not convenient to share. A mowing machine, for example, one nearly always wishes to use at the same times as one's neighbour, but those things which are only required two or three times a year are excellent items for a co-partnership to consider.

I have already referred to the most economical crops—using the word economical in its strictest sense. Broadly speaking, these are the early and late crops. It simply does not pay in these days to grow main-crop potatoes, but it does pay to grow early potatoes. Fruits and vegetables which do not reach the shops in good condition, e.g. lettuces, raspberries and strawberries, have an added value when they are gathered fresh from the garden. Flowers in the winter and spring months are more valuable because at that time they cost more in the shops. It will therefore be seen that all the steps that can be taken to secure these crops are well worth-while. But the construction of greenhouses and frames costs money. Their maintenance and their heating also entail recurrent expenditure.

The gardener, therefore, would be well advised to consider carefully the merits of the different types of greenhouse at present available. It must be said at once that all the different materials used for greenhouse construction have their advantages and disadvantages. Concrete, for example, is almost indestructible. Metal has a long life but is fairly expensive. Wood is easy to work and the ordinary amateur, if he be a handy-man, can make adjustments and repairs to a wooden greenhouse more easily than he could to a metal or a concrete one. First cost and subsequent maintenance are two factors which must be considered when choosing a greenhouse. Similarly, one has to remember that in any greenhouse it is necessary to have a path not less than 2 feet wide, preferably

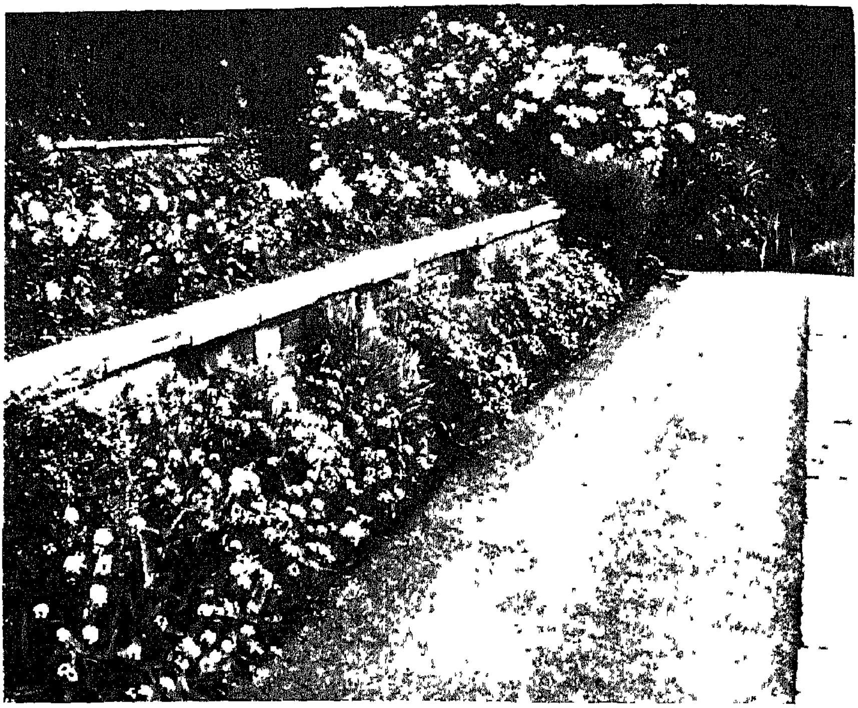
2 feet 6 inches wide. If one compares the first cost of the different types of greenhouse by the simple method of working out the cost per square foot of the growing area covered, that is to say, the area of benches or borders in which plants can be grown, *it will be seen that the area covered by the path is* an important factor.

The wider the greenhouse, within limits, the greater the area of effective growing space and, therefore, the less the cost per square foot of ground covered by glass. This means that, generally speaking, a greenhouse 10 feet wide is more economical per square foot than a greenhouse 8 feet wide.

Perhaps more important than the materials used in the construction of a greenhouse is the design of the house. It has now been established that light is a more important factor than heat in the early months of the year—the months when the early crops are being matured or the foundations are being laid for successful crops later in the season. Much experimental work has been done in recent years on the design of greenhouses and now certain firm conclusions have been arrived at. In the early months of the year the sunlight strikes the house at a low angle. The research workers have been able to determine the angles at which the sides of the greenhouse should be pitched to permit the low spring sunshine to penetrate the house with the minimum of refraction. In this sphere, science has progressed considerably in recent years and gardeners may now derive the benefit from the discoveries of the research workers.

And then we come to the heating of greenhouses. It is safe to say that there has been no more perplexing problem than the attempt to reconcile the various claims by manufacturers of the heating apparatus. With solid fuel so much depends upon the efficiency of the boilers and also upon the ability of the stoker. The varying qualities of solid fuel also have to be taken into consideration. The use of oil for greenhouse heating is a modern development, and again it is difficult to obtain comparable figures for fuel utilization and general performance. Electricity provides a means of heating greenhouses that is much more accurate when we come to discuss fuel utilization. The article on the heating of greenhouses in this issue is the first we have ever seen which goes fully into all these problems, and if the reader is sufficiently interested to make use of the information contained therein he will be able to come to his own conclusions about the various methods of heating greenhouses.

This brings us back very nearly to where we began. We must accept that for many gardeners a greenhouse is a necessity. They are prepared to accept the initial costs and the expenditure involved in greenhouse maintenance because they feel that the results they will obtain from a greenhouse are well worth-while. But in this, as in every other department of the garden, any saving in labour is welcome. So if one wishes to have heated greenhouses and frames

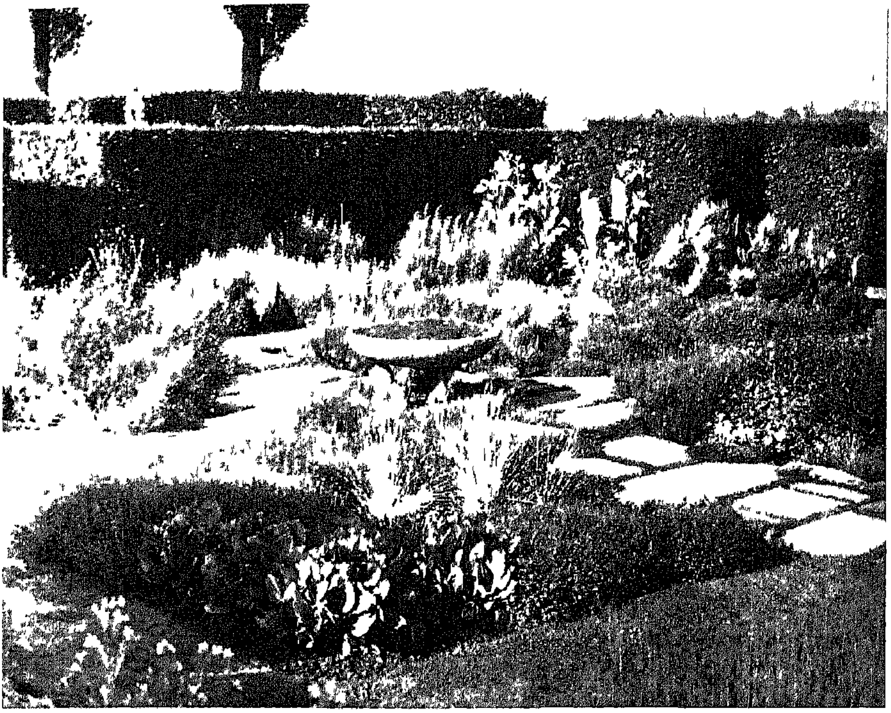


THE VALUE OF TERRACING

*A slope in a garden is a great asset By terracing it with brick or stone walling three borders are obtained with endless possibilities for planting*

SKILFUL PLANTING

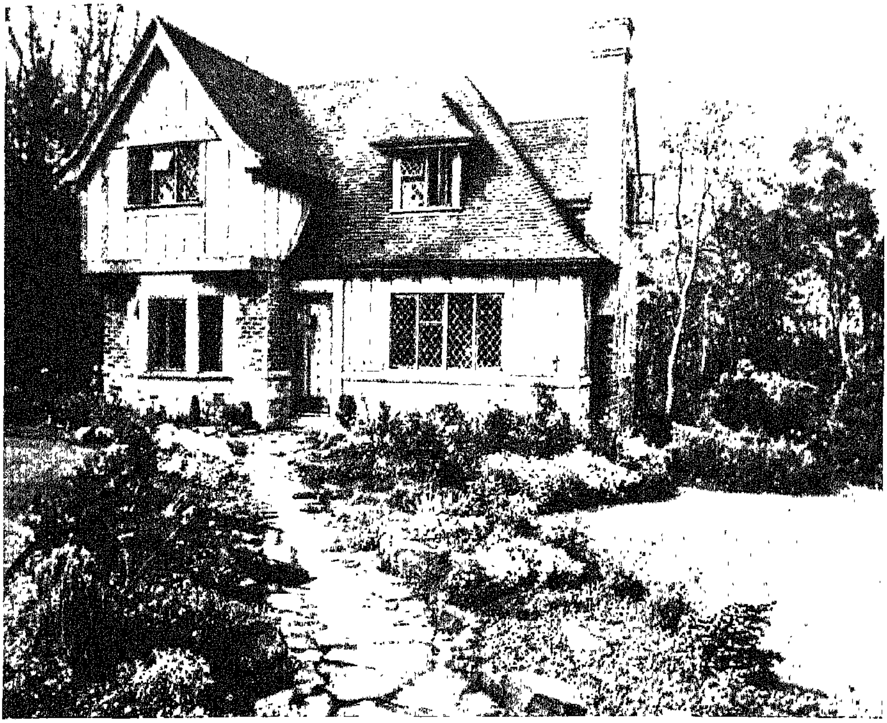
*Seasonal interest throughout the summer may be had by skilful planting First the irises bring colour—later the old-fashioned roses take up the tale*



*A formal garden is made interesting and attractive with the minimum of cost and maintenance by planting it with herbs and grey-foliaged plants*

LOW MAINTENANCE

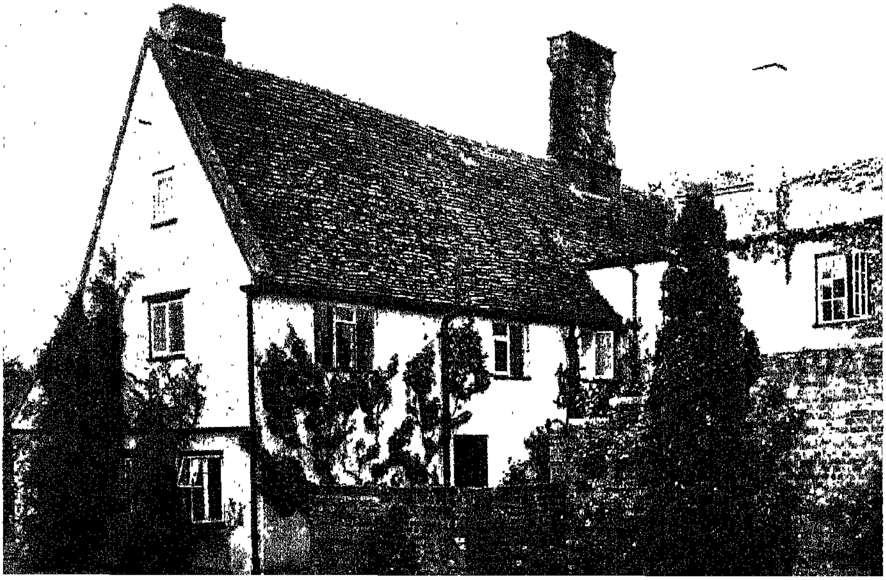
*This is an excellent way to have a lovely garden. Let rough grass lead to a rock garden with stepping-stones to guide the feet*

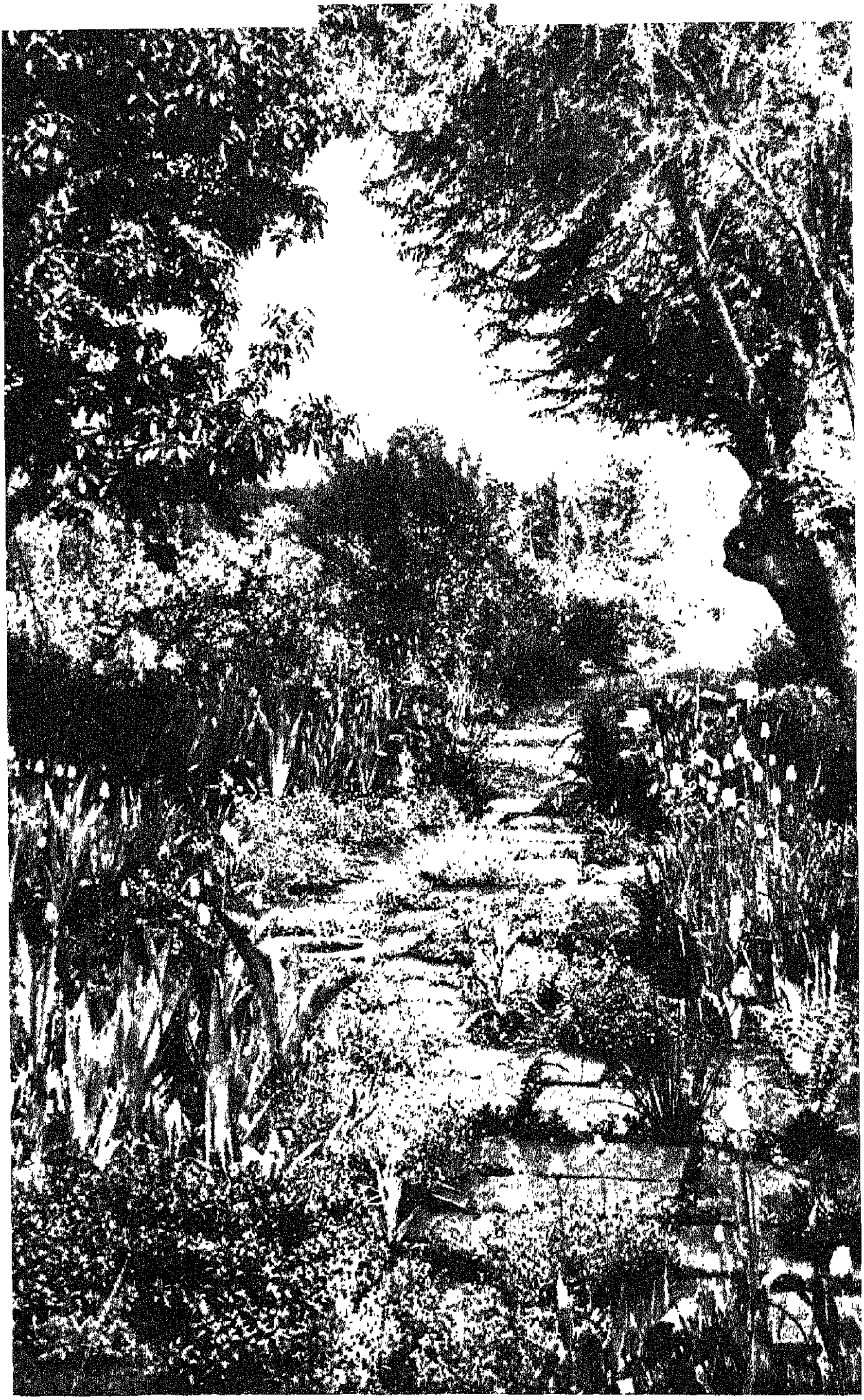


*Studied informality is the keynote of this modern garden. Low-growing plants are used in the borders which may be admired from both sides*

BLENDING WITH ARCHITECTURE

*Simplicity and easy maintenance have been achieved in the surroundings of this delightful home*



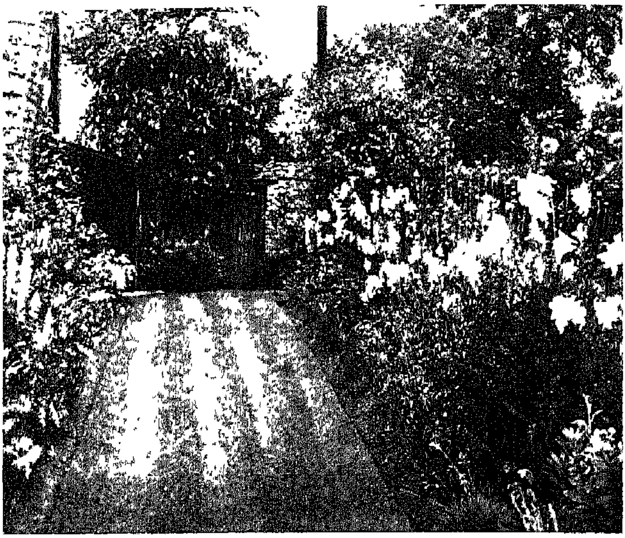


*Never under-estimate the beauty of hardy ferns In the proper setting they can be infinitely beautiful*

⇩

*The smallest garden can be lovely with well-tended turf and borders gay with lilies, lupins and other summer flowers*

⇩



PLANNING
SMALL
SPACES

LONG-TERM
PLANTING

*It would scarcely be possible to carry simplicity to greater lengths than in this charming garden. It has, of course, the priceless gift of water*

STUDIES IN SIMPLICITY

*Simplicity again is the feature of this "turn-court". A "fussy" treatment would have detracted from the charm of the house*

*Borders of hardy flowers give the best return for a gardener's money and time*

BORDER TREATMENT

*A polyanthus border with standard roses is an idea well worth copying*

with the minimum of expenditure of time and trouble, electricity is the answer. It is clean, automatic and labour-free. Of course, not every garden is in the fortunate position of having electricity at hand. But if electricity is available it is now obvious that it can be a real boon to the "week-end gardener" and to the garden-owner who nowadays has to be his own head gardener.

To those who would boggle at the inclusion of greenhouses and frames in a book mainly concerned with labour-saving, we would only say that there are few gardens which do not depend upon the use of glass to bring on their plants at some time of the year and gardeners are a strange race. What is an insupportable burden to one, is a joyous pastime to another, but we feel that all of them will be glad to know of the ways in which time and effort may be saved because the true gardener never has enough time to do all the things he would like to do, and if he can let the machine or a thermostat shoulder some of his burdens he will have more time to devote to the practice of his real gardening skill or to the enjoyment of the results of his labours. A selection of beautiful gardens providing ideas for the layout of larger and small areas is included in this issue. The right labour-saving equipment can reduce working time in them all.

We are fully aware that there are many other aspects of this great subject which we have not touched upon in this volume. We hope, however, that our contributors, each expert in his own field, have revealed enough of the problems they know so well to stimulate the reader to further investigation and to enable him to follow with interest the new developments that are constantly taking place in the horticultural world.

With the publication of this sixth volume of *Gardens and Gardening*, we have now surveyed a very wide field covering most of the problems with which the average gardener is likely to meet; we have also provided expert advice on the use and treatment of a wide variety of plants suitable for many different purposes. It is our hope that those of our readers who have made a collection of all these volumes, will find them an inexhaustible fount of information and a valuable work of reference for many years to come.

THE EDITORS

# *Reconditioning the Garden*

### By Dr. W. F. BEWLEY

ALTHOUGH MANY OF US PREFER TO LEAVE ANY ATTEMPT AT CORRECTING THE faults in our gardens until the warm days of summer and autumn have passed, there are many opportunities of attending to important jobs during that part of the year. Certainly they are done more comfortably on a mild evening than when a cold wind is whistling around. In any case it is a good plan to walk around during the summer—notebook in hand—and decide what must be done before the spring.

For my own part, I believe in having odd corners cleaned up during the summer, not only for aesthetic reasons, but also because many insect pests are more active then and the sight of large numbers of woodlice, millipedes or beetles, heaving and twisting, impresses upon us the urgent need for a good clearing up. Insects and small animal pests of all kinds love untidy corners littered up with pots, boxes, straw, paper and all manner of debris. So get busy—clear them out and you will be surprised how much more space you have got when the job is finished!

It is often a good plan to scatter a handful of crude whizzed naphthalene in corners where insects have been lurking, unless, of course, there are some valuable plants just at that spot. Corners behind rain-tubs or garden frames, with a brick wall behind, can be treated in this way, for even if the insects are not destroyed they are usually driven out of their hiding places; where dangerous pests are hibernating and it is essential to destroy them, a dusting with B.H.C. dust is called for. It is effective against many insects and small pests. These odd corners are often forgotten and neglected, yet they are important centres from which constant troubles emerge in the form of snails, slugs, millipedes, woodlice, beetles and caterpillars of all kinds.

It is also a good plan to clean out garden frames and disinfect them with a formaldehyde solution, because they will dry readily in the summer weather and be ready for autumn work. Disease organisms of many kinds can remain active in and on garden frames and be a serious menace to any plants placed inside them. They are readily destroyed by a 2 per cent solution of formaldehyde prepared by mixing 1 pint of 40 per cent formaldehyde solution in 49 pints of water. Garden frames can be treated with this solution by spraying it all over them and then covering with sacks or hessian. Pots and boxes can also be sterilized by dipping them in the solution until saturated, then covering them up under sacks for forty-eight hours and finally laying them out in the sun to dry. Canes used for supporting plants should also be sterilized in the same way.

It is advisable, always, to dry the sterilized articles thoroughly and then store them under cover, except, of course, for the frames which are sterilized *in situ.*

## CULTIVATION OF THE SOIL

The soil in many gardens suffers because it is so seldom dug properly to any depth. It is true that many light soils or those with a light subsoil can remain in a healthy condition for a considerable time without digging, but the same does not apply to medium and heavy soils.

Every attempt should be made to dig the subsoil whenever an opportunity occurs, even if it is only for the purpose of assisting drainage away from the top soil. Thus, whenever a herbaceous border is being replanted, the whole bed should be cleared, and then dug over deeply and manured before replanting.

It is most important that, during the rare occasions when the ground is free for cultivation, organic matter of a lasting nature should be applied to it.

Good strawy horse manure is a most valuable type of organic material, which is suitable for all kinds of soil. It is, of course, expensive, and in many cases we must search for cheaper substitutes.

In this respect it is useful to remember how manure of this kind works in the soil. The amounts of nitrogen, phosphate and potash it contains are very small, and often inadequate for many crops. It does, however, also contain the minor elements like magnesium and manganese, which are very important.

The chief value of horse manure lies in the strawy material and the active microbial population which lives upon it. Not only does the straw open up the soil and improve its aeration, but it replenishes the soil population and helps to keep it in a healthy condition. In addition, it holds water like a sponge and so provides an ample store without interfering with the soil atmosphere. A good substitute for horse manure can be obtained from straw by fermenting it in a suitable manner.

It was Dr. H. B. Hutchinson and the late Mr. E. H. Richards of Rothamsted who first learned how to change any kind of cellulose material into a form resembling really good well-decayed farmyard manure by a simple process of fermentation.

The first step is to wet the material thoroughly, and in the case of straw it takes 800 gallons of water per ton of straw. The straw will not absorb all this at one time, so the wetting is usually done in four stages, applying 200 gallons of water to each ton of straw four times at intervals of three to five days. The wet straw would ferment slowly in any case, but to hasten matters it is necessary to mix with it a certain amount of nitrogenous material—usually sulphate of ammonia—and in this case the amount is ¾ cwt. to a ton of straw. After mixing this in thoroughly the heap of straw will rise in temperature quickly and fermentation proceed in the normal way. After a time it will slow down because the heap of straw tends to become acid. The addition of chalk will prevent this, so the process is, after wetting the ton of straw, to add the ¾ cwt. sulphate of ammonia and also 1 cwt. chalk so that fermentation will start rapidly and continue without check until the straw has broken down to the desired condition. Cyanamide or any other nitrogenous material will do instead of sulphate of ammonia or, indeed, one of the proprietary accelerators.

Although straw is recommended for commercial crops, there is no reason why the process should not be applied to many other kinds of cellulose material, such as leaves, grass, crop residues and even hedge clippings—all of which can be turned into good compost—provided, of course, they were free from disease when they were put into the heap.

On some soils, any kind of strawy manure or compost breaks down and disappears very rapidly. In such cases the opening or aerating effect does not persist very long and therefore it is better to use material more resistant to decay.

A very cheap type of such material is sawdust, but if mixed with the soil without the correct pre-treatment it is likely to cause denitrification. This is always liable to happen when fresh cellulose material is mixed with soil, because the organisms which grow upon it also need nitrogen. So as they decompose the cellulose they also break down nitrogenous compounds near by and, in doing this, they deplete the soil of nitrogenous plant foods. In this way they destroy nitrates or in other words cause denitrification.

In the case of materials like chopped straw, paper, and wood sawdust, it is the parts which are most readily fermentable that cause the most trouble. Thus if they are wetted and a little nitrogenous matter and chalk is mixed with them, they will quickly ferment and after about four weeks they will have changed sufficiently for them to be mixed with the soil in a garden without the danger of starting denitrification.

Another material popular with gardeners is peat, for although this has no fertilizing value it is clean and when added to the soil it both improves aeration and holds a store of water. In other words it improves the air-to-water relationship in the soil.

Recently a form of shredded poplar bark has come to us from the match factories. It has been well pulverized in a mill—carefully shredded and turned into a most useful kind of organic material for garden work. It makes a most excellent mulch, for although it is soft it lasts long in the soil. Dug into the soil, with a little nitrogen to prevent any possibility of denitrification, it keeps it open for a long time. It is suitable for pot plant work and altogether is a valuable new product.

### HEAVY SOILS

Many new householders face the difficult task of breaking up the most dreadful clay material around their homes and forming a pleasant garden. Those in authority and, indeed, the builders themselves could surely have a little mercy on those who are destined to live in the houses they erect, by leaving the land in a more suitable condition for garden-making. As it is, around most large towns there is the problem of turning a heavy clay soil into a workable condition. The farmer does this by systematically ploughing and cultivating it and by the incorporation of organic matter and probably lime. The gardener breaks it up with fork, pickaxe and anything he can lay hands on, expending considerable personal energy at the same time.

He read of the coming of the chemical soil-conditioning powders with no little interest, for they seemed likely to lighten his labours to a considerable degree. And so they do—but unfortunately they have first to be mixed intimately with the heavy soil and this is a task of some magnitude, and, of course, the conditioners themselves are expensive at present although they will become cheaper.

These soil conditioners, of which Krilium was the first to be introduced into this country, are worth persisting with on very heavy soils, because once the job of getting them mixed into the soil has been accomplished its physical state changes remarkably and it can be dug quite easily afterwards. Furthermore, soil treated in this way holds water longer, is better aerated and can be turned into a fertile state quicker than the heavy untreated land.

Soil conditioners are not fertilizers; they were never intended to be, but they help to make fertilizers more effective on heavy soil, because they improve its physical state.

Many gardeners fail to produce the best, because their land is so poorly supplied with plant foods.

During such times as different areas of the garden are cleared of plants, the opportunity should be taken to dig deeply and apply not only coarse organic matter to open up the soil, but sufficient fertilizer to keep the plants going. Coarse hoof and horn meal and also a good wool shoddy are useful as a "bank" of nitrogen, while coarse bone meal or even broken bones are good sources of phosphate. Such material is insoluble in water, but it is broken down slowly by soil fungi and bacteria and then rebuilt into soluble plant foods. This slow method of providing small quantities of nitrogenous and phosphatic nutrients in the soil is sound policy and good husbandry. It ensures that the plants are never starved and also that valuable food substances are not wasted by being washed out of the soil, as they are when heavy dressings of soluble fertilizers are added to the soil at a single application.

Two ounces of each to the square yard is a reasonable dressing for most plants, with an equal amount of sulphate of potash, although twice this amount is often needed for heavy crops of vegetables.

A good supply of phosphates ensures that the plants will have good root systems and they are particularly important for young plants trying to establish themselves in new quarters. Older plants do not seem to need them so much.

One of the troubles we often encounter in our gardens is the fact that so much of the fertilizers we add to the soil are locked up in insoluble form so quickly that the plants have little chance to get hold of them. This is especially true of very chalky soils, as gardeners know so well. Not only does this apply to the major elements like phosphorus, but to many minor elements like iron, which is necessary to preserve the normal healthy green colour of most plants.

In very chalky soils, many kinds of plants tend to become yellow, and this lime-induced chlorosis, as it is called, has always been difficult to control. Usually the cause is lack of soluble iron and perhaps potash also, because the chalk in the soil has rendered them insoluble. In the past, additions of extra iron in the form of iron sulphate, iron citrate and so on, with or without nitrate of potash, have sometimes improved the colour, but in very chalky, alkaline soil they usually failed for the simple reason that the newly added soluble salts are soon rendered insoluble after coming into contact with the soil.

Recently iron and many other metals have become available in what are called chelated forms. These are the sequestrols of iron, aluminium, magnesium, etc. Now these sequestrols are very interesting forms and will be very useful to the horticulturist when they become somewhat cheaper, for they are so constituted that the metal is bound up in the molecule in such a manner that it is not precipitated in very alkaline solutions or in chalky soils.

Thus the sequestrol iron mono-potassium complex dissolved in water at a concentration of only 1 in 1000 is the almost perfect cure for chlorosis of hydrangeas, for it causes the yellow leaves to assume a good green colour within a few days of the soil being watered with it. Furthermore, the sequestrol aluminium complex will bring out the beautiful blue colour of hydrangea flowers in the same way. Recent experiments with other chlorotic plants, including the black currant, have yielded equally satisfactory results.

It is of course possible to deal with some forms of chlorosis in a different way. For instance, in the case of greenhouse-grown roses a form of chlorosis, in this case due to manganese deficiency, has been treated successfully by adding flowers of sulphur to the soil. The manganese deficiency happened because the soil was so alkaline that the manganese was locked up in an insoluble form. The addition of sulphur was effective because it was quickly oxidized to sulphuric acid. This reduced the alkalinity of the soil, rendered some of the manganese soluble, and so provided the rose trees with the manganese they needed so badly. The green colour of their leaves was restored rapidly.

## DISEASES AND PESTS

The obvious diseases and pests are so well known and so much written about today that anyone who is interested can get all the information he needs very quickly.

What is much more difficult to identify is the sick condition so many of our plants develop and which continues to baffle so many of us. This is only because we do not really appreciate that weak plant growth may be due to causes other than fungi, bacteria and insects or small animals.

How many plants are lost because they are planted in such a way that the soil around their roots is always airless, over-wet and badly drained! Roots must have plenty of air and oxygen, otherwise they cannot feed. Careful planting and a handful of sand or grit under the roots will often make all the difference in the world. We know it is essential when planting lilies and choice bulbs—why not our other valuable plants. Then there is the other extreme of the poor plant that is left with its roots hanging in a hole without any visible means of support. More careful planting to see that the roots are in contact with the soil all round always pays. Many a plant which with a little care would have delighted the eye for many years never gets a chance because its roots live in a tight, airless, over-wet soil. Roots of plants must breathe, so attend to the physical condition of the soil and never forget that plants cannot thrive when the soil is in bad physical state. Indeed, good physical condition is much more important than an abundance of food.

# *A Comparison of Wood, Metal and Concrete for Greenhouse and Frame Construction*

By A. C. BUNT

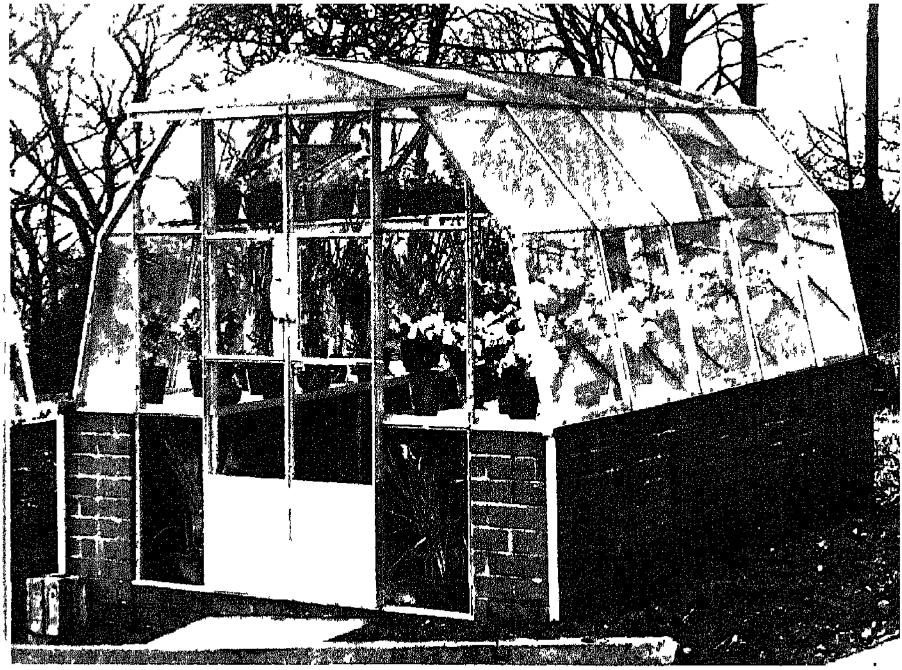
WOOD HAS FEATURED PROMINENTLY IN THE CONSTRUCTION OF GREENHOUSES during the course of their evolution from the beginning of the nineteenth century to the present day. Indeed, in the early greenhouses there was considerably more wood than glass. With their development for the growing of commercial crops the design has progressed and the ratio of wood to glass has been reduced. More recently, substitutes have been used in place of wood. The post-war shortage of timber has stimulated the use of metal and concrete.

Before considering the design and materials best suited for its construction, it is pertinent to ask ourselves what we desire from a greenhouse. Its purpose is to enable us to extend the growing season of some crops and to grow others which would not normally survive in our climate. It is at once apparent that to accomplish either of these things we must grow the plants in a structure which can both provide shelter and be heated by some means.

The importance of light was largely overlooked by the early greenhouse designers and it is only recently that its full significance has been realized. As any greenhouse owner knows, it is far more difficult to maintain a high standard of cultivation during the months of November to February. In this period the days are shorter and the light intensity is low compared with the rest of the year. The total amount of light received during a typical December day is only about 10 per cent of that of a June day. So low does the amount of winter light fall below the optimum level for plant growth that it has been found profitable to give supplementary illumination to tomatoes and cucumbers during the early propagating season. It will be clear from this that while keeping heating, cooling and ventilation in mind, light is the most important consideration in greenhouse design.

Now consider materials for its construction and points in its design.

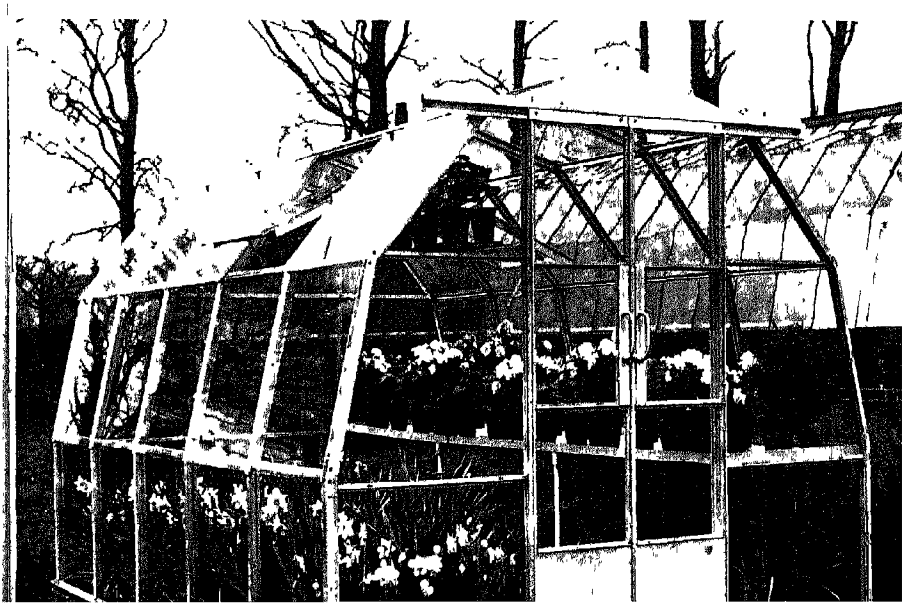
*Glass.* The main surface area should consist of a material that has a high light transmission, is water- and weatherproof and also durable. To date, there is no substitute for glass which transmits 91 per cent of the sunlight it receives when the incident angle is normal, that is, the light strikes the glass at a right angle. The angle of incidence is important, as this determines the transmission figure.

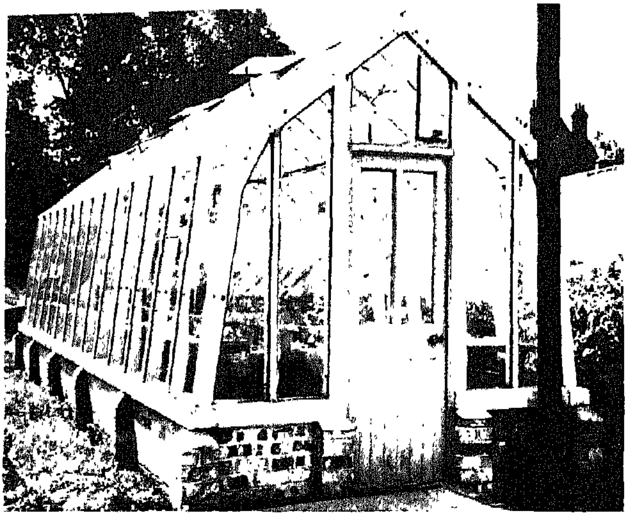


*A metal-frame greenhouse with bench-high walls, a useful house for propagation*
*(V & N Hartley Ltd)*

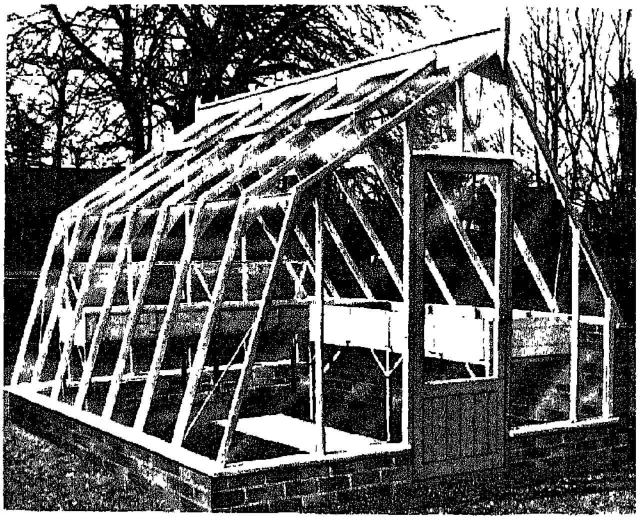
METAL-FRAMED

*A dual-purpose, metal-frame house with a border for early crops and convenient benches for pot plants, seed-raising and other propagation work (V & N Hartley Ltd)*

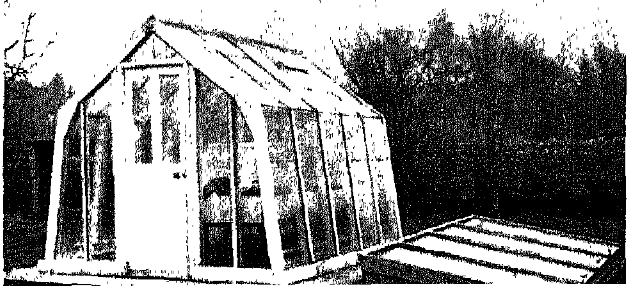




*A concrete house on a low brick foundation fitted with benches and heated by a coke boiler (G. W. King & Co. Ltd.)* ⇦

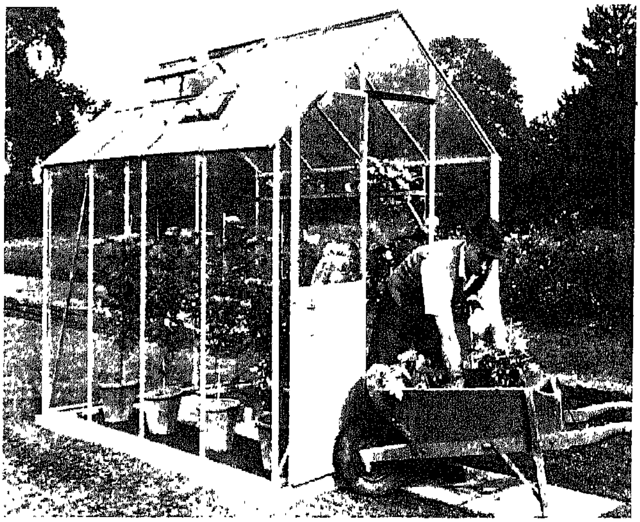


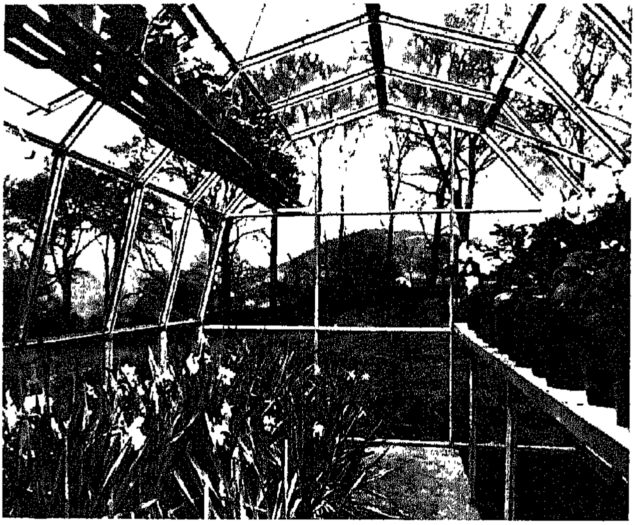
*A timber house of the most modern design with sides set at angles to admit the maximum of low-angle spring sunshine (The Agricultural Supply Co.)* ⇨



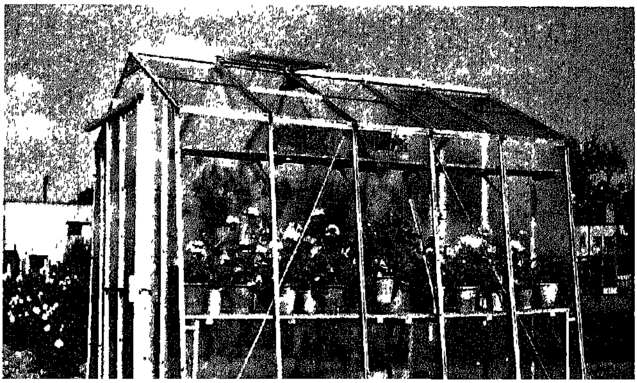
*Set on a concrete base at ground-level, this concrete*

*With a minimum of metal glazing bars, this is an excellent type of small, inexpensive house for growing chrysanthemums, tomatoes or other crops requiring plenty of light (The Crittall Manufacturing Co. Ltd.)*

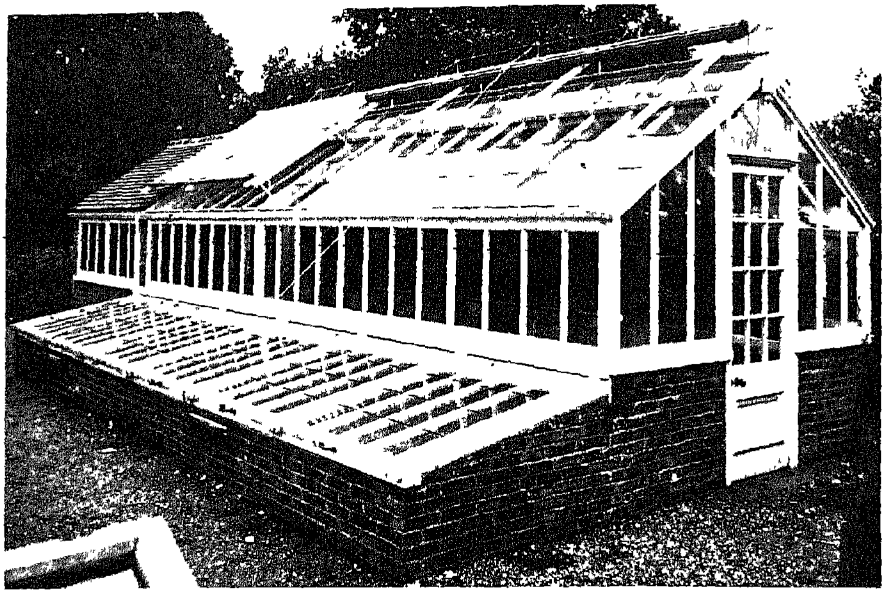




*By using shelves, a surprising number of pot plants may be accommodated in a small house. In this model there is ample head room above the border for shelving (V. & N. Hartley Ltd.)*



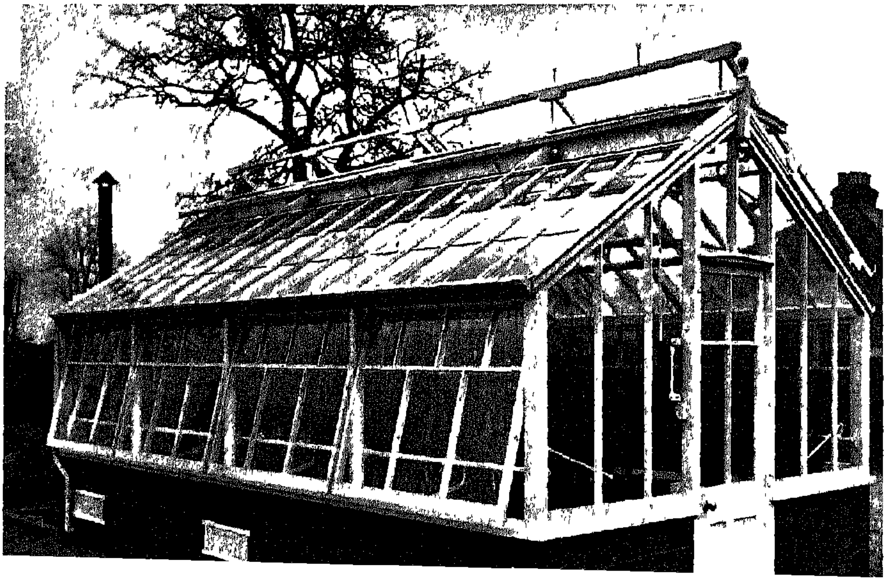
*Easy erection and low maintenance are features of this*



*An excellent general-purpose timber house fitted with lath blinds. At one end is a tiled potting-shed section and the brick pits benefit from the greenhouse heating* (*Wm. Wood & Son Ltd.*)

WOOD ON BRICK

*A well-constructed timber house of proved design with plenty of ventilation at low and high levels* (*Wm. Wood & Son Ltd.*)



For instance, with an incident angle of 60° the transmission is 82 per cent. Horticultural glass is normally $\frac{1}{10}$ inch thick and weighs 24 ounces per square foot. The maximum width which can be supported on two sides only is 24 inches. Several attempts have been made to use glass having a selective wavelength transmission, but these experiments were unsuccessful from a commercial point of view.

### STRUCTURAL MATERIALS

*Wood.* The main advantage of wood has been its low capital cost and the ease with which it can be worked. Because of the extreme conditions of heat and humidity, not all timbers are suitable for greenhouse construction. Ideally, the wood should be capable of supporting the greenhouse and this includes the weight of the glass, adequate allowance for wind-pressure, maintenance work on the roof, ancillary equipment, and so on, without resorting to the use of large sections. The wood should also be durable, an important point in these days of high maintenance and replacement costs. Teak is sometimes used for greenhouse construction. It is strong, has a long life and can be used without painting, but where reflected light is important it is customary to apply a coat of white paint. The present high cost of this wood, however, eliminates it except under special conditions.

Oak also is strong and durable, but special care has to be taken to see that it is fully seasoned before being used. Oak is notorious for twisting and distorting unless especially selected. Before the war, western red cedar was used extensively for greenhouse construction, especially for roofs, and it is now becoming available again. This wood is durable and light but is not as strong as either teak or oak. Because of the lack of strength, either larger sections must be used or adequate support given by other timbers. When steel nails are used with western red cedar they are liable to corrosion and this is followed by structural weakness to the timber. To prevent this, only galvanized nails and brass screws should be used. Baltic redwood or Scots pine is another timber commonly used. This is neither as durable nor as expensive as any of those mentioned above.

Shortly after the war, when all soft-woods were in short supply and were only available for greenhouse building against licences, several West African hardwoods were introduced; of these, niangon and agba were considered the most satisfactory for greenhouse construction. They are more expensive than soft-woods but are expected to have a considerably longer life with less maintenance. It should be pointed out that while the hardwoods are approximately twice the cost of soft-woods, the overall cost of the greenhouse is increased by not more than 10 per cent.

*Timber Preservation.* Where timber is kept under permanently dry conditions and the moisture content does not exceed 20 per cent, decay which is caused by fungal attack does not occur. In the humid conditions of a greenhouse most timbers gradually absorb moisture and so become liable to decay. There are two main ways of preventing this: the wood can either be impregnated with a preservative which is toxic to the decay fungi, or it can be painted to prevent the entry of water. The preservatives do not give a waterproof seal. They are usually mercurial zinc or copper compounds and can be used in either water-soluble form or with a volatile spirit solvent. The water-soluble types are cheaper but are more liable to leaching. With both types of preservative the wood can be painted to improve its appearance after it has either dried out or the solvent has evaporated. It has been estimated that preservatives will double the life of the timber, especially if applied under pressure.

Until recently it has been customary to use paint as a means of prolonging the life of timber. The object in painting is to prevent the entry of water into the wood by applying a moisture-impermeable barrier. It is difficult to achieve a continuous barrier in practice and even then it is easily damaged. Once water gains admittance through the damaged barrier, decay may take place under an apparently sound exterior. In addition to providing a waterproof seal, the paint should be resistant to both bacterial decomposition and breakdown caused by light. Aluminium paints are particularly suitable for greenhouse work. They have the unique ability to form a metallic "leaf" surface which is impermeable to water. They are also resistant to photo-chemical breakdown. The life of white lead paints is, to a great extent, governed by their ability to prevent the entry of water. As soon as the water enters the wood through cracks, joints, etc., the wood swells and the paint is lifted. Flexibility in paint would appear to be as important as durability. Decomposition of the oil base in paints can be prevented by the inclusion of zinc oxide and titanium oxide. Synthetic enamels which do not have an organic base, and also chlorinated rubber paints, are now being tried for greenhouse painting. Looking into the future, it seems probable that preservatives will replace painting.

Recently a bar-cap of thin aluminium alloy has been introduced from the U.S.A. It is fixed over the roof bar with a layer of putty. This prevents water from entering the wood and eliminates the need for painting.

*Aluminium.* Aluminium alloys would appear to be the most suitable of the metals for greenhouse construction. Pure aluminium is non-corrodible but is soft. To give it strength, an alloy is made by including small amounts of other metals. Duralumin, for instance, has small quantities of copper, manganese and magnesium. In alloy form, aluminium has great strength and an unlimited life with negligible maintenance. Because of the high tensile strength small sections can be used, leaving more space for glass, and thereby giving higher light transmission. It can be extruded (shaped) to almost any section. *Figure 1* shows a typical modern alloy glazing bar. When aluminium is brought into contact with steel a slow electrolytic action occurs, causing corrosion. For this reason alloy nuts and bolts are preferable to steel, even when the latter are galvanized. After exposure a surface oxidation film develops and the alloy loses some of its brightness, but painting is not required.

Because of the different rates of expansion of aluminium and glass, the standard type putty which hardens with age, is not suitable. Plastic compounds which remain pliable are used or, alternatively, the glass is bedded on to a non-adhesive material, e.g. asbestos string. A glass-to-bar joint without a glazing compound is unsatisfactory because of the poor seal which can let in both water and cold air. The glass is held to the bar either by metal clips or by narrow strips of aluminium approximately the same length as the glass. These narrow strips are screwed or clamped to the glazing bar and, in addition to holding each pane of glass firmly against the bars, form a rest for the pane above and so prevent it slipping down. This system of glazing allows a broken centre pane of glass to be replaced without having to move the other glass in the row.

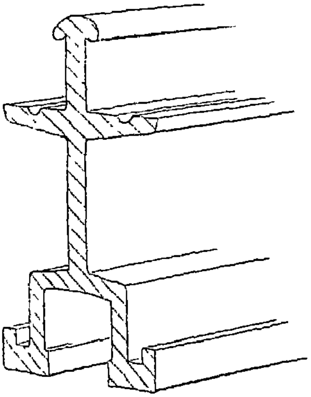


Fig. 1

There are two main types of aluminium construction. One employs unsupported roof bars of 1½ to 2-inch depth, the other uses smaller bars supported either by main members at intervals or by bracing with rib type supports. Provision should be made to collect and remove to the outside of the house condensation which sometimes forms on the underside of the bars.

*Steel.* Because of its liability to corrosion and the difficulty of preventing this, steel is not considered as satisfactory as aluminium. Where steel is used it should first be given a corrosion-resisting coat by dipping in zinc. It should also be painted frequently, and where rust has developed this must first be scraped away and then a priming coat of red lead or metallic zinc paint given before applying the white finishing coat.

Many of the points regarding the use of aluminium, condensation grooves on the bars, method of fixing glass, etc., apply equally to steel. Mild steel angle sections can successfully be used for the main structural work with small section wooden glazing bars. It is also used for purlin posts, ventilator mechanisms, and so on.

Metal houses may be up to 20 per cent more expensive than timber. Against this must be considered the potential longer life and low maintenance costs.

*Concrete.* As with aluminium and steel, the popularity of concrete for greenhouse construction owes much to the post-war shortage of timber. When reinforced with wire rods concrete is strong and durable. Against this must be considered the large sections which must be used. To obtain good light transmission the size of glass should be increased to "Dutch light" size, i.e. 56 inches by 27¾ inches. The pre-stressed type of concrete may prove suitable for future use.

### ASPECT AND DESIGN

However well it is designed, the choice of site to a large extent determines the amount of light in the greenhouse. It should be free from the shadows formed by buildings and overhanging trees and, where possible, should have an unobstructed view to the south. There are two important factors regarding winter light: (1) in winter the sun shines in Britain on average for not more than 20 per cent of the hours of daylight; (2) the greatest amount of diffused light comes from the south. By siting the greenhouse east-west in preference to north-south a better light transmission is obtained from the larger area of glass facing south. If the slope of the roof is changed from the conventional even span to a three-quarter span, with the long shallow roof facing south and the short steep roof facing north, the shadow from the ridge bar which would normally fall on the plants in the north half of the house is eliminated.

To obtain maximum light transmission the glass should be not less than 24 inches square. Small glass means more bars which obstruct light and more overlaps through which heat is lost. A new development in timber construction is the introduction of the gusset type of joint, *Figure 2.* This joint is made by inserting a triangular sheet of laminated wood where the glazing bars meet at the ridge and at the eaves. Because of the saving in timber, the cost is not increased and the light transmission is higher. A further increase in light is obtained by placing the gutters at ground-level instead of at the eaves. If the house is to be used for growing bed crops—tomatoes and lettuces, for example—the glass should rest on a low wall, not higher than 1 foot. The small house with wood sides 2 to 2½ feet high is not suitable for bed crops.

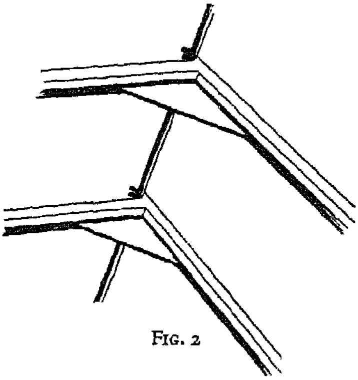


FIG. 2

So far we have only considered light from the plants' point of view. There are, however, other important aspects. The higher the light transmission the warmer the house and the soil will be during the day. This means that less fuel will be used and also the soil will be warmer for growing early crops.

It is also worth considering the bed or bench arrangement before making a purchase. Often the pathway occupies an uneconomical percentage of the house. If we assume that 3 feet is the maximum width of bench it is possible to handle in comfort and 2 feet 6 inches is sufficient for a path, then a house 8 feet 6 inches wide gives the maximum amount of bench per unit width. With a house 10 feet 6 inches wide the benches must be increased to 3 feet 8 inches to give the same ratio of bench space to total greenhouse area. A further point of consideration is the number and sizes of greenhouses to purchase. Large greenhouses are generally cheaper to build per unit area than small ones. This is because the materials are more economically used and it is usually cheaper to make two units from one large greenhouse by erecting a suitable partition rather than to build two small ones having the same total area. Also, it is easier to maintain a suitable climate in the large house.

## TYPE OF HOUSE

Having decided the size and the material with which to build our house, we are left with the choice of permanent or portable houses. The permanent type can be either a metal or timber house secured to a concrete foundation. While it is possible to move these houses, it is a major operation and seldom attempted.

It is sometimes convenient to use an existing wall or the side of a house as the basis of a "lean-to" greenhouse. If this is done it is important for the reasons given earlier that the wall faces south. It has been argued that in winter the reflected light from a white surfaced wall compensates for the loss of northern light by reflecting light from the south. This has been disproved by recent experiments.

The Dutch light structure can be either wood or metal, but in place of the customary roof bars with the glass firmly attached, the single sheet of Dutch size glass is generally used. Usually the glass is in a light wooden frame made from 2 inch by 2 inch timber and is secured to the structural frame of the house. Ventilation is provided by lifting either whole lights or half lights at intervals in the roof. It is possible to construct a Dutch light house without the use of structural timbers. The lights are held in position by being clamped together and so support one another. Because of the high glass to wood ratio, light transmission in Dutch light houses is usually good. It is sometimes considered that this type of house is expensive to heat because of the high air change rate caused by imperfect joints. Dutch light houses are, however, used for permanent glass and can be heated quite successfully, especially when the joints are sealed. They are usually considerably cheaper than either type of conventional greenhouse.

The cooling of greenhouses under conditions of high solar radiation can be a problem, as ventilators in small greenhouses are usually inadequate in both size and number. Often only a single small ventilator is fitted on one side of the roof. To be effective, ventilators ought not to be smaller than 3 feet by 2 feet, and with a house 12 feet long, at least two and preferably four such ventilators should be fitted in the roof. In addition, either side or box ventilators are required. It is not generally realized that to keep a greenhouse cool on a hot summer day, the air may require to be changed sixty or more times per hour.

A recently introduced automatic ventilation control, worked by a sensitive modulating thermostat, keeps an even temperature in the greenhouse within the limits of the amount of cooling it is possible to obtain from ventilation. This device, together with automatic heating control, makes it possible to leave the greenhouse unattended for long periods.

When full ventilation is not sufficient to cool the house, it is necessary to prevent the full amount of radiation from entering by the use of blinds. Either tiffany or wood lath blinds should be kept in mind when selecting the house.

*Frames.* The choice of materials and design for frame construction is largely determined by the crops it is intended to grow. Permanent frames, as used for raising bedding plants and certain pot plants, are usually constructed from bricks or sectional concrete. These materials are cheap and durable and are difficult to improve upon. The English type of light, measuring 6 feet by 4 feet with glass 14 inches by 10 inches, is most commonly used for permanent frames. When early salad crops are not grown, this type of light is probably suitable, but where the emphasis is on early crops the French and Dutch lights are better. Both these types transmit more light than the English type. The French light measures 4 feet 4 inches by 4 feet 5 inches and has 12 inches by 14 inches glass which is supported by small T-section irons instead of the wooden sash bar as used in the English light. Because of the small glass size, maintenance due to breakage is much lower with this type than with the Dutch light.

Permanent frames can be either sited facing south or north, depending on the crop. Single frames for early salad production are usually sited facing south, and where double frames are used these are orientated north-south to give even illumination in both frames.

Because of the frequency with which the frames are moved, wood is usually used for the base or frame walls. The double light frame uses less material than the single frame but does not generally produce such early crops. The lights of single frames and the soil base are sloped at an angle of 15°. The object of this is to trap the low-angled winter sunlight which warms the soil and hastens maturity. To gain maximum benefit from this heating the glass should be not more than 9 inches above the soil level. The closer the glass is to the soil the warmer it becomes.

# *Heating of Greenhouses*

By A. W. GRAY

ANY GARDENER COULD BE FORGIVEN IF, ALREADY POSSESSING A GREENHOUSE OR having decided to purchase one, he imagined that the provision of an efficient heating system was only a matter of having the necessary cash and then going out and ordering suitable equipment. Unfortunately, it is not as simple as this, because the number of people selling equipment who are capable of giving sound advice on greenhouse heating in all its aspects is very limited.

The solution is, of course, to go to a bona fide heating engineer with experience of greenhouse heating, but often this is either not possible or convenient.

Fortunately, it is not difficult to marshal the facts, once it is realized that to maintain the temperature inside a greenhouse it is essential to replace the heat lost through the fabric—i.e. glass, wood, brickwork and so on—to the outside air, through the floor or soil into the subsoil, and by ventilation. The heat transfer rate or thermal conductivity of all these materials in units of heat called British Thermal Units—B.Th.U.s for short—is well known, and so by measuring the surface area of each type of material in the structure, and multiplying this by the appropriate thermal conductivity figure, we can arrive at the heat loss per hour from the structure for each degree Fahrenheit difference between the inside and outside temperature, and so know what amount of heat will be required to maintain 1°F. temperature lift inside the greenhouse. The thermal conductivity figures for the more usual greenhouse materials are given below:

| *Material* | | *Thermal Conductivity B.Th.U./Sq.ft./Hr.°F. diff.* |
|---|---|---|
| Horticultural glass | | 1·0 |
| Wood | 1 inch | 0·5 |
| Wood | 1½ inch | 0·4 |
| Brickwork | 4½ inch | 0·6 |
| Brickwork | 9 inch | 0·5 |
| Brickwork | 13½ inch | 0·4 |
| Concrete | 4 inch | 0·6 |
| Concrete | 6 inch | 0·5 |
| Steel | ⅛ inch | 1·2 |
| Concrete on brick floor | | 0·2 |
| Soil | | 0·33 |

The amount of heat required to raise the air temperature in the greenhouse by 1° F. over the outside temperature is the basic figure, but to calculate the heating requirements of the greenhouse and so assess the required capacity of the heating equipment, a further figure, the "temperature lift", is necessary. The "temperature lift" is the difference in degrees Fahrenheit between the maximum air temperature which will be required in the greenhouse during the coldest part of the year, and the lowest outside temperature against which this inside temperature has to be maintained.

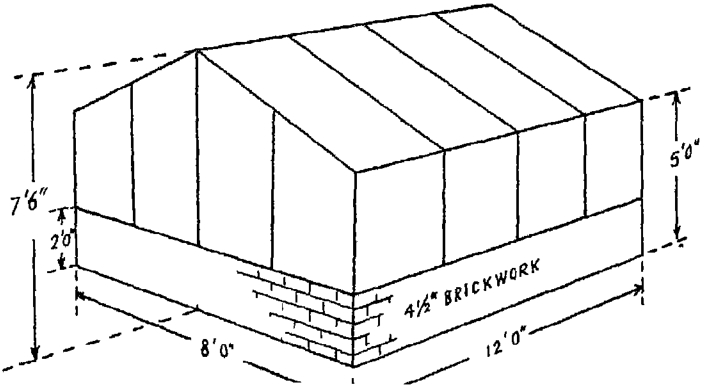
In England many heating recommendations are based on a minimum outside temperature of 32° F., but experience shows that this is far too optimistic, and an outside temperature of 20° F. should form the basis of greenhouse heating calculations. Thus, to maintain an air temperature of 50° F. inside the greenhouse during the winter months, equipment capable of providing a 30° F. temperature lift is required—i.e. the difference between the required inside temperature of 50° F. and the outside temperature of 20° F. For an inside temperature of 60° F., the heating requirements would be 60° — 20° F.=40° F. temperature lift.

The final calculation is therefore as follows—firstly, find the heat required to raise the temperature in the greenhouse by 1° F., and then multiply this by the temperature lift figure. The result will be the heating requirements in B.Th.U.s necessary to maintain the required inside temperature against the minimum outside temperature.

The whole method of working out is best illustrated by the following example, based on a temperature requirement of 50° F. during the winter months in a 12-foot by 8-foot greenhouse with dimensions and constructional details as shown in the sketch. It is not necessary to differentiate between glazing bars, etc., and the glass, neither is notice taken of the construction of the door, as these differences would have little effect on the final figure.

## EXAMPLE

Greenhouse 12 feet long by 8 feet wide, constructed as in sketch, heating requirements to maintain an inside temperature of 50° F. against an outside



temperature of 20° F., with minimum ventilation during period of low outside temperature.

HEAT REQUIREMENT 1° F. RISE

| *Fabric* | *Dimensions* | *Area Sq. ft.* | *Thermal Conductivity B.Th.U.s/Sq.ft./Hr./1° F.* | *Heat Loss B.Th.U.s/Hr./° F.* |
|---|---|---|---|---|
| GLASS | Sides: | | | |
| | 3′×12′×2 = | 72 | | |
| | Roof: | | | |
| | 4′9″×12′×2= | 114 | | |
| | Ends: | | | |
| | 4′3″×8′×2 = | 68 | | |
| | *Total glass area* = | 254 | × 1·0 = | 254 |
| BRICKWORK | Sides: | | | |
| | 2′×12′×2 = | 48 | | |
| | Ends: | | | |
| | 2′×8′×2 = | 32 | | |
| | *Total brick area* = | 80 | × 0·6 = | 48 |
| FLOOR | Soil: | | | |
| | 8′×12′×1 = | 96 | × 0·33 = | 32 |
| | | | *Heat Loss* = | 334 |
| | | | *Add one-third for Fortuitous Loss, Air Leaks, Ventilation, etc.* = | 111 |
| | | | *Total Heat Loss B.Th.U.s/Hr./° F.* = | 445 |

TEMPERATURE LIFT

50° F. inside temperature — 20° F. outside temperature = 30° F.

## HEATING EQUIPMENT

Heating required = 445 B.Th.U.s/Hr./° F. rise × 30° F. temperature lift = 13350 B.Th.U.s per hour.

Having arrived at the actual heat value necessary to maintain the required temperature rise of 30° F. inside the greenhouse, this must now be related to the thermal efficiency—that is, the percentage of potential B.Th.U.s in the fuel actually made available inside the greenhouse for heating purposes—of the chosen heating equipment. This varies with the alternative methods, and is generally taken as:

Solid fuel—coal, coke, etc. = 50%
Oil = 75%
Electricity = 100%

Based on these efficiencies, the alternative equipment rating would be as follows:

Solid fuel $\frac{13350 \times 100}{50} = 26700$ B.Th.U.s/Hr.

$\frac{13350 \times 100}{75}$ 17800 B.Th.U.s/Hr.

While the thermal efficiencies given above are those generally accepted, they should be taken with some reserve, as each is dependent on a number of variable factors, the most important of which are initial installation, fuel and management. These are dealt with at some length in the appropriate sections.

Having calculated the amount of heat necessary to provide the temperature required in the greenhouse, the next step is to consider the alternative methods of heating available, solid fuel, oil and electricity, and the alternative types of equipment available in each range.

### SOLID FUEL

The traditional method of heating a greenhouse is by water, heated by a coal-fired boiler, circulating through cast-iron pipes around the greenhouse, giving off heat partly by radiation but mainly by convection. As might be expected, in view of the many years that this method of heating has been in use, there is a wide range of equipment available, ranging from the smallest boiler similar in size and design to the boiler in common use for providing domestic hot water, to the multi-section boiler used on commercial horticultural holdings for heating large blocks of greenhouses.

Generally, the smaller size boilers are designed with a single water jacket around the firebox, the heat being transferred by conduction into the water through the walls of the firebox. The heated water passes into the heating system through a flow pipe in the upper part of the water jacket, and returns to the boiler for reheating by means of a return pipe in the lower portion.

While all boilers work on the same system of flow and return, in some of the more efficient small boilers, and in the majority of larger boilers, the system of heat transfer is somewhat different. Instead of a single all-round water jacket, the water flows through a number of individual waterways at the sides and top of the firebox, these being joined to common flow and return pipes situated at the top and bottom of the boiler respectively. Heat direct from the fire is passed by conduction through the walls of the firebox to the side waterways while the water in the upper waterways is heated partly by radiation from the fire, but primarily by the hot flue gases. These upper waterways are so arranged as to form part of the flue, and so present the maximum surface area to the hot gases which circulate around them, giving up the maximum heat to the water in passing and so increasing the overall efficiency of the boiler.

The choice between these two types of boiler will depend very largely on the overall heat requirements, but where even quite a small boiler is required, it will usually be good policy to pay the somewhat higher initial cost of the multi-way boiler, as this will soon be offset by higher efficiency, better utilization of fuel, and consequent saving in running costs.

The type of boiler having been decided upon, the further points to be considered are concerned with the actual installation of the boiler. In the northern hemisphere, for greenhouses running north to south, the boiler should be situated at the north end of the house. This will ensure that light to the greenhouse is not obstructed by the boiler, chimney and fuel bins. Further, and most important advantages, are that the prevailing winds which are usually south-west to west will carry the smoke and smuts away from the greenhouse, so avoiding dirty glass which is a major cause of loss of the natural light so essential to plant growth particularly during the winter months, at the same time ensuring that the harmful sulphurous fumes from the chimney do not enter the greenhouse through the door or ventilators to the detriment of the plants growing inside. Another advantage of this position for the boiler is that the flow pipe near to the boiler, which is at a higher temperature than the remainder of the heating system, will enter the house at the north and usually the colder end, and so tend to equalize the heating throughout the greenhouse.

For the house running east to west, the boiler should be at the east end for the same reasons, and with similar advantages.

Although some boilers are designed to be built into the end wall of the greenhouse, the majority are free-standing, and for this type it is essential that it is installed as near to the greenhouse as possible, keeping the length of pipework to and from the greenhouse, which of necessity is exposed to the outside air, to a minimum. This, with efficient lagging of the boiler and of the exposed pipework, will ensure that heat loss is kept to a minimum. Failure to pay due attention to these details will result in excessive heat loss, an inefficient heating system and increased heating costs.

Most of the smaller boilers are supplied complete with smoke pipe or chimney, but for the larger types it is necessary to build a chimney. Whether this be an iron pipe, or a brick chimney, care must be taken to ensure that the height and internal capacity are adequate for the particular boiler. Too often, the chimney is regarded merely as a means of getting the smoke away from the boiler and from the vicinity of the greenhouse; this is a great mistake, as the chimney is in fact the key to the efficient burning and control of the fire in the boiler. Unless the chimney provides an adequate and steady draught, the dampers are useless ornaments, and control of the burning rate of the fire is impossible. It is usually a good plan to decide on the height of the chimney, and then, while building, add a further 2 feet to the height for good measure.

To finish off the boiler installation, some cover against the weather should be provided, and if this can be extended to cover the fuel bins, so much the better. It must not, however, be so enveloping as to interfere with a free flow of air to the firebox.

The size and type of boiler having been decided upon, and the installation planned, the next and very important point for decision is the length and size of heating pipes to be installed, and the layout which will best fit in with the planned use of the greenhouse. The pipe-run usually consists of two pipes running from the boiler to an expansion box at the end of the loop, the top pipe being the flow pipe and running at a higher temperature than the lower pipe, which returns the cooled water to the boiler for reheating. The expansion box should be so arranged that it provides a rise in the run of the flow pipe from the boiler, and, conversely, a fall in the return pipe so as to induce a gravity flow and thus assist in a free circulation of the water through the system. The size and length of pipework will be decided by the amount of heat which has to be introduced into the greenhouse to provide the required temperature lift.

The heat given off by the pipes by radiation and convection is governed by the temperature difference of the water in the pipes, and the air to be heated, and so the calculation must be based on the water temperature when the heating is working at maximum rated output. In the majority of installations, the water temperature in the flow pipe during colder weather will be about 180° F., but as the water in the return pipe will be some degrees cooler, a mean temperature of 170° F. should be taken. However, whatever the water temperature at which the installation will run at time of maximum heat demand, as long as this is known when planning the pipe layout, reference to the table below will show the size and length of pipe necessary for the particular installation.

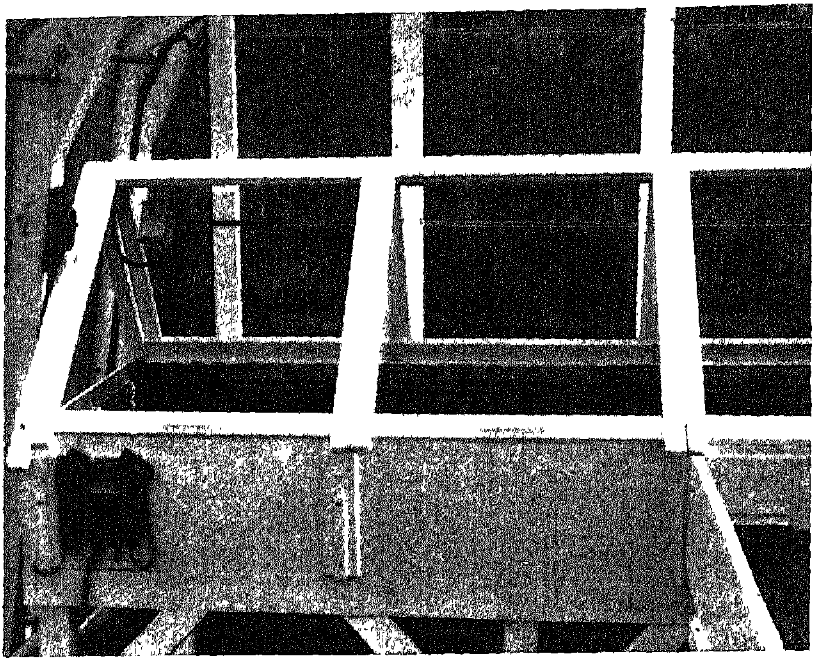
IRON PIPE TRANSMISSION

B.Th.U.s per Lineal Foot per Hour

| *Nominal size of pipe* | *Temperature Difference (Fahr. degrees) Between Air and Water* | | | | | | |
|---|---|---|---|---|---|---|---|
| *inches* | 60 | 70 | 80 | 90 | 100 | 110 | 120 |
| 2½ | 79 | 96 | 115 | 135 | 154 | 174 | 194 |
| 3 | 96 | 118 | 141 | 165 | 188 | 212 | 237 |
| 3½ | 107 | 130 | 156 | 182 | 208 | 234 | 263 |
| 4 | 119 | 145 | 174 | 203 | 232 | 262 | 292 |
| 5 | 144 | 176 | 212 | 247 | 282 | 318 | 354 |

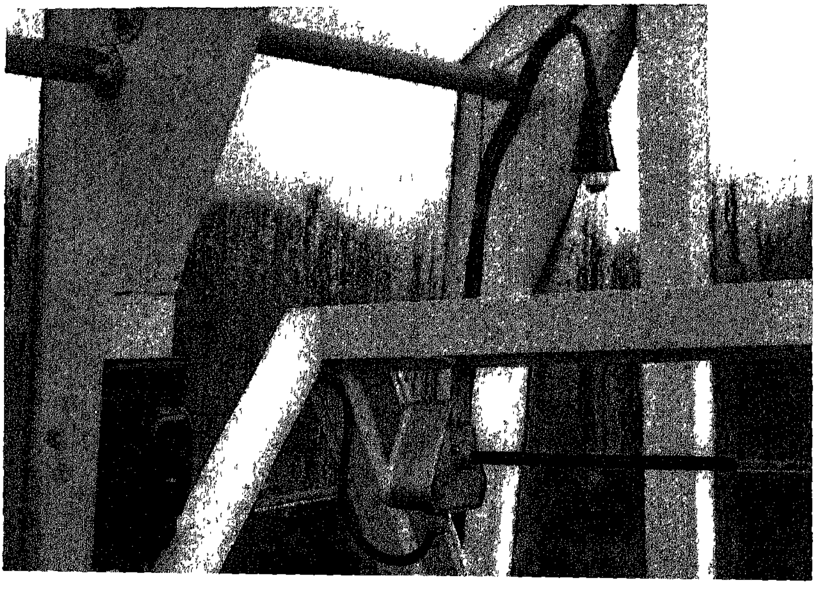
*N.B.* For the greenhouse dealt with in the example on page 42, requiring 13,350 B.Th.U.s per hour to maintain a temperature of 50°F. in the house, and with a mean water temperature of 170°F., the difference between air and water temperature is 120°F. Reference to the table will show that the heat transmission per foot run of 4-inch pipe is 292 B.Th.U.s, and therefore 46 feet of 4-inch pipe will be necessary to provide the heat requirements. Alternatively, 51 ft. of 3½-inch pipe, or 57 ft. of 3-inch pipe would distribute the necessary heat.

Once the installation is completed, management of the boiler will decide the overall efficiency of the heating system in providing the temperature



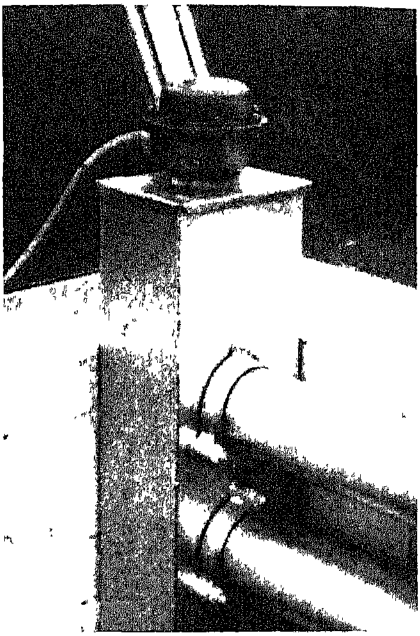
*An enclosed propagating bench with soil-warming cables and thermostatically controlled space-heating cables*

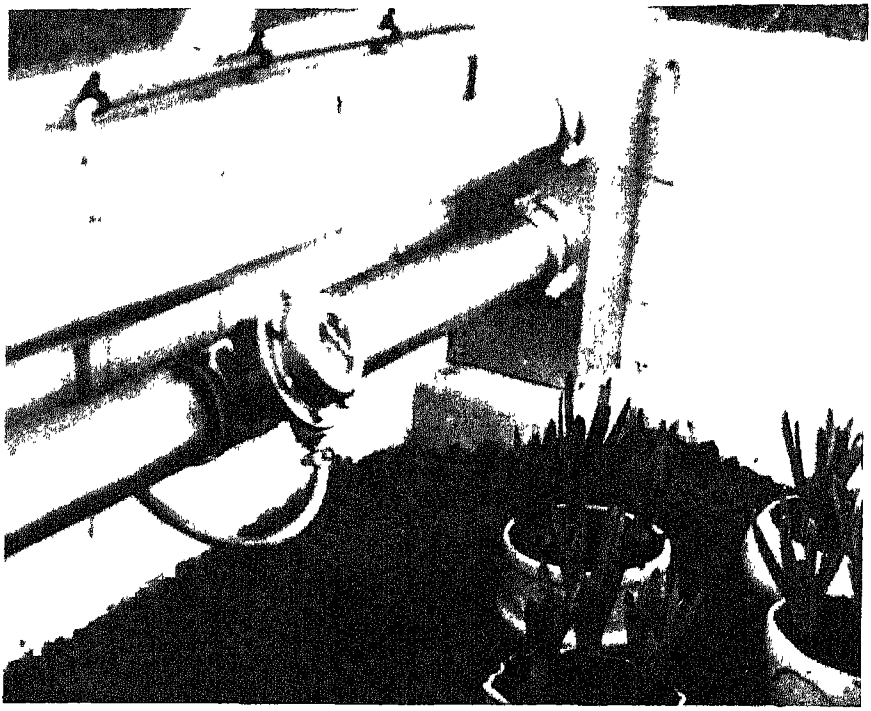
*A close-up of the rod-type thermostat controlling the air temperature in the enclosed propagating bench shown above*



⇧
*Electric immersion heater being fitted into end tank of hot-water heating system*

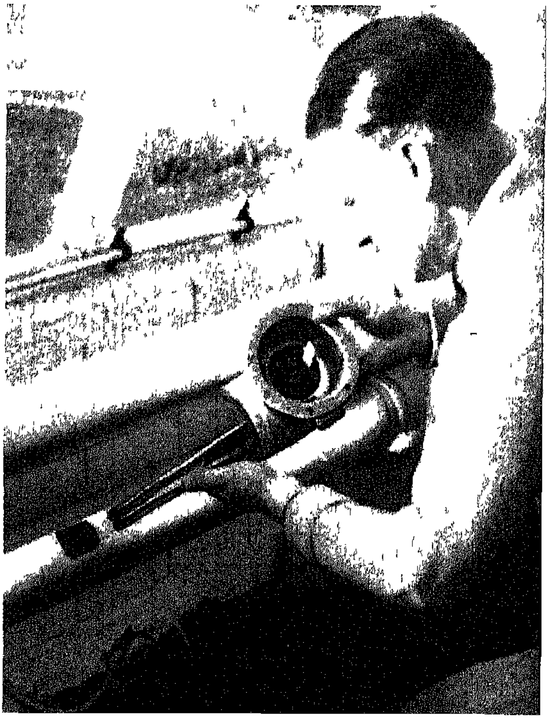
*Immersion heater in position  Bottom portion of heater only heats up, providing circulation by means of convection* ⇩

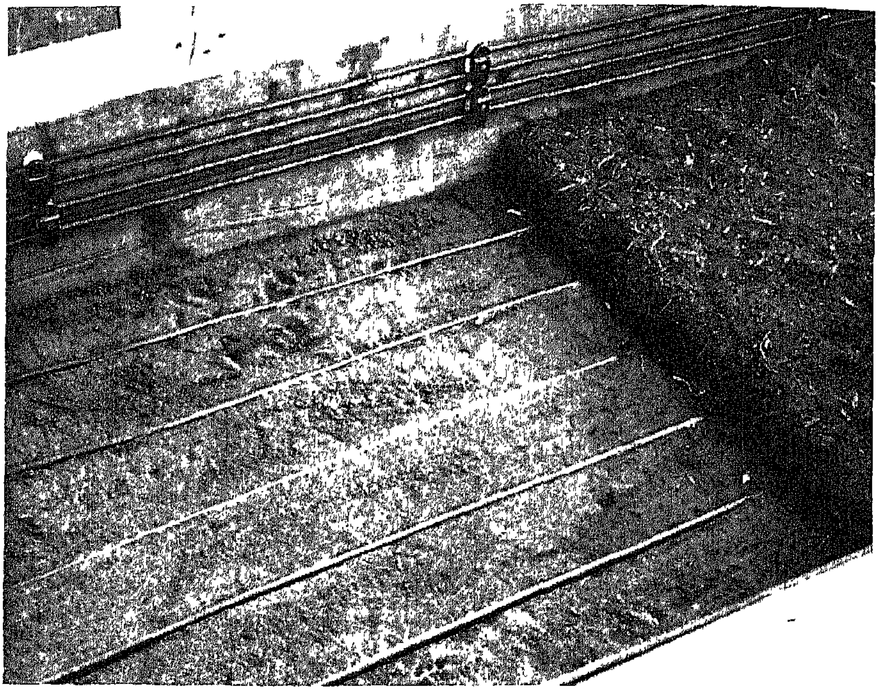




⇧
*Immersion heater in position Where additional heaters are required these are fitted in line and are adjacent*

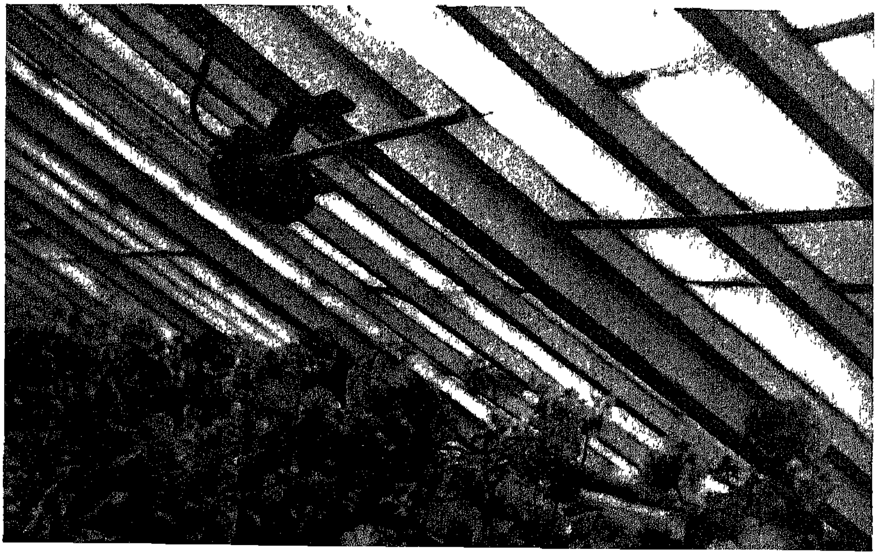
⇦
*Horticultural tubular heaters mounted just above the borders*





*Soil-warming cables laid on sand and covered with sand and bark fibre in enclosed propagating bench*

*Rod-type thermostat mounted near the greenhouse ridge, to control tubular heaters*



requirements at all times for the minimum of running cost. The important points to remember are:

*Fuel:* Having found by experience the most suitable fuel for the particular boiler, stick to it. The most expensive is not necessarily the right one.

*Stoking:* Remember that a flat, even fire is better than a lumpy fire piled high in the middle.

And finally, and possibly the most important: The burning rate of the fire. The amount of draught will decide this, so set the damper or draught control to keep a steady rate of burning, just sufficient to maintain the required temperature in the greenhouse. It is also important to remember that an increase of 5° F. over the minimum temperature required will double the running cost for the cool house—up to 50° F.—and increase it by over 60 per cent for temperatures above 50° F.

It is possible to gain some measure of automatic control of the system by fitting a water temperature control in the boiler. This is in fact a draught regulator, and is operated by a bellows which expands and contracts according to the temperature of the water in the boiler, and in so doing operates a lever which raises or lowers the draught door, so regulating the draught through the fire and consequently the burning rate. This control is particularly useful for the gardener who is away from home during the daytime, and also for taking care of any sudden change in conditions during the night.

## OIL

Of recent years oil as an alternative to solid fuel for providing heating for the greenhouse has attracted considerable interest—mainly because an adequate supply of the correct grade of oil is more easily obtained than a sufficient quantity of good-quality solid fuel, but also because oil is clean to use, less bulky to store and, when burning, gives off less smoke and dirt than most solid fuels. The boiler and pipe layout of the oil-fired heating system is similar in practically all respects to that required for solid fuel, the exception being that the firebox in the oil-fired installation is fitted with refractories—a form of firebrick capable of withstanding very high temperatures—in place of firebars. When converting a solid fuel boiler to oil firing, suitable refractories can be purchased separately and are quickly and easily fitted. The heat in the firebox is provided by burning oil mixed with air introduced as a fine spray at high pressure through a mixing nozzle or jet into the firebox.

The oil is fed from the storage tank to the burner by gravity and atomized by a stream of air which is introduced into the burning nozzle by a separate air pipe from an air compressor driven by an electric motor. The amount of oil and air vapour, and so the size and intensity of the flame, is regulated by a motorized valve operated by a thermostat installed in the greenhouse, so giving automatically controlled temperature conditions in the greenhouse.

Creosote and the lighter oils will run quite freely to the burners at ambient temperatures, but when heavier oils are used, as is the case in many commercial installations, then the oil from the storage tank is fed by gravity into a small heating tank fitted with an electric immersion heater. In this tank the oil is heated to a temperature sufficient to allow it to run quite freely to the burning nozzle, and fluid enough to vaporize quite easily.

The choice of the right size boiler, correct installation and planned pipe layout are just as important to the overall efficiency of the oil-fired system as to the solid fuel installation, but, as with the latter, management is the deciding factor in the efficient use and economical running. The main points to watch are that the correct size jet is used from the start; that the mixture of oil and air is carefully balanced to ensure complete combustion and, above all, that the oil-burning equipment is kept scrupulously clean at all times. As with the solid fuel installation, the heat distribution and overall efficiency of the oil-fired system will be increased if an electrically-driven circulating pump is fitted in the system.

The oil-fired hot-water system is excellent in all respects for the large heating system, but for the medium-size greenhouse the initial cost of the heating equipment—storage tanks, compressor, burner and controls—is high in relation to the heating to be provided. On this score of first cost alone, such equipment is usually quite out of the question for the small greenhouse, but an alternative means of heating by oil is provided, with self-contained oil heaters.

These heaters, burning paraffin, consist of an oil storage tank, usually of one gallon capacity, a burner with a circular cotton wick, and a metal chimney. The heat is given off from the heater mainly by convection, the height of the flame, and so the heat output, being regulated by the height of the wick above the flame guards.

Most makes of heaters are available in one- or two-burner models, usually with the same size storage tank, so that while the two-burner model gives off double the heat of the single burner, it requires refilling twice as often.

It is often difficult to obtain precise information as to the heat output of this type of heater, because most leaflets show only the burning rate or consumption of oil per hour. However, a fair indication of the heating capacity of a particular heater can be obtained where the burning rate per hour is known, as a heater consuming ¼ pint of paraffin per hour will, if it is in good condition and properly trimmed, give off approximately 3500 B.Th.U.s per hour. To obtain the best results from these self-contained oil heaters, it is essential that the heater is kept scrupulously clean and that the wick is carefully trimmed and properly adjusted.

This type of heater can be useful for frost protection in a cold house when the hours of burning and the number of occasions on which it will be used are relatively few, but its use for continuous heating needs rather more careful consideration. The fumes given off by burning oil are injurious to most plant life, and while many plants will tolerate a small amount for a short time, there is the possibility that when sufficient heaters are installed to maintain a given temperature, say 50° F. inside the greenhouse against 20° F. outside, a build-up of fumes sufficient to inhibit growth, if not to cause irreparable harm to the plants, would take place. A contributory factor to such a build-up would be that the minimum of ventilation is usually given during the colder weather when the maximum of heating is required, and so giving rather more ventilation during colder weather than is usual with other forms of heating, and paying particular attention to the cleaning and trimming of the heaters could, to some extent, minimize the risk of plant damage from the oil fumes.

### ELECTRICITY

Statistics, if available, would no doubt show that electricity is being used for the majority of new greenhouse heating installations, and that every year more and more gardeners are replacing other forms of heating by electrical heating. The reasons for this are not hard to find when we consider the advantages that a properly designed electrical heating system can afford. It is clean, it can be controlled to fine limits of temperature; it is completely automatic in operation, doing away with the drudgery inherent in alternative methods of heating, and altogether it provides a complete heating service.

Electricity is there on tap, there is no need to worry as to whether the next load of fuel will arrive before the present stock is used up, always supposing that we have remembered to get our order in on time. There is no storage problem, a boon to the tidy gardener who deplores, but has to put up with, the unsightly fuel heap which is taking up valuable space anyway. It is clean; gone are the chances of murmuring from the neighbours when the fire is giving off a trifle more smoke than usual and the wind is in the wrong direction, and gone too is the chance of fumes in the greenhouse, cancelling out one's best efforts.

Automatic control, and this should always be provided, ensures that the correct temperature is kept, no matter what the changes in the weather, and only the gardener who has had to turn out last thing at night in all winds and weather to stoke the boiler can properly appreciate what a blessing this can be. Long days at the office, and the occasional night away from home will no longer give rise to anxious wonderings as to the state of the weather at home or the capabilities of the substitute stoker, if the electrical heating installation is thermostatically controlled.

The thermostat which operates by changes in the air temperature of the greenhouse is really the brains of the electrical heating installation, switching the heating on and off as required to maintain the correct air temperature in the greenhouse. The efficiency of the heating installation, as well as the running costs, will depend to a very large extent on the correct functioning of the thermostat, and so it is essential that the proper type is used. The best type of thermostat for controlling greenhouse heating is the "rod" type with waterproof head. It is specially designed for greenhouse work, operating within fine limits of temperature and constructed to stand up to the arduous conditions of high humidity, and so on, met with in the greenhouse.

The "rod" type thermostat should be fixed horizontally and approximately one-third of the way along the house from the door, and one-third of the way down from the ridge. It is best hung from brackets screwed into the roof members, and some 6 inches to 8 inches away from the glass. It is an advantage to screen it from the direct rays of the sun, but the screening must on no account interfere with the free circulation of air around the thermostat, otherwise the accuracy of control will suffer.

There are numerous types of electrical heating equipment, and details of these are given below. Provided the equipment is safe and reliable, the choice of type and make is entirely a matter of personal preference and price. All will give satisfactory service, provided that the installation is properly planned, as to layout and loading, and correctly installed.

The tubular heater, consisting of a hollow metal tube of approximately 2½ inches diameter, containing a heating element running the full length of the *tube and supported on a flat mica strip, is the most popular electrical equipment* for greenhouse heating. These heaters are simple to install, take up very little growing space and give an excellent heat distribution.

Any equipment which is to be in continuous use in a greenhouse must stand up to very arduous conditions of high humidity and high temperatures, as well as to the often corrosive effects of smokes and sprays, and so tubular heaters have been specially designed for greenhouse heating. These heaters, energized at mains voltage—usually 240 volts—are watertight and made of aluminium.

The electrical loading of the "horticultural" tubular heaters is 60 watts per foot run of tube, and as they are available in lengths from 2 feet to 17 feet, little difficulty will be experienced in building up the electrical loading required with heaters of suitable lengths to fit into the layout for a particular greenhouse. The heaters are fixed on brackets around the walls, or in wood stakes driven into the soil close to the glass. Where more than one row of heaters is required, the heaters are mounted one above the other with a separating distance of about 3 inches between the tubes, the bottom heater being about 8 inches from floor or soil-level.

The heat is given off partly by radiation, but mostly by convection, and so care must be taken to ensure that the heaters are not fixed under an overhanging ledge, as this will prevent free circulation of the warmed air and so interfere with the efficient distribution of the heat. When tubular heaters are fitted beneath a bench, this should stand at least 6 inches away from the wall or glass, to allow the warmed air to flow quite freely up from the heaters and between the bench and the glass.

An alternative to tubular heaters which are energized at mains voltage—usually 240 volts—is the low-voltage heating equipment. This consists of a grid or grids of galvanized tube energized at low voltage—not exceeding 30 volts—from a transformer. The grid of tube is the heating element, the low-voltage current flowing through the tubes causes them to warm up and so distribute the heat throughout the greenhouse.

The grids are fixed to the walls of the greenhouse on wooden battens, and so sited as to allow a free circulation of the warmed air. The transformer should be installed in the greenhouse immediately adjacent to the grids. The low-voltage equipment cannot be bought "off the shelf", as each set of grids has to be built up to provide the electrical loading required, and of a size and pattern to fit into the particular greenhouse for which it is designed.

An entirely different type of equipment is the fan unit heater, in which the air is blown by a fan over a heating element, and so circulated around the greenhouse. The positioning of the heater is very important, as the air leaves the unit at a comparatively high temperature, and care must be taken that the stream of hot air does not blow directly on to the plants. Fitting the heater over the doorway is often the solution in the smaller greenhouses, and once the heater is fixed the direction of the air stream can be adjusted in some measure by means of louvres on the front of the unit.

For the gardener who already has a boiler and hot-water pipes, there are available electrical conversion units, which replace the boiler and yet use the pipes to circulate the heat round the greenhouse. When converting a solid fuel system to electrical heating, the boiler is disconnected and the flow and return pipes are connected by a small water tank. Electrical immersion heaters—similar in design to the heaters used in the ordinary domestic hot-water system—are fitted into the system either in the connecting tank or directly into the return pipe. These heaters can also be used as an auxiliary to a boiler, to give an additional heat boost and some measure of protection against damaging low temperatures in the event of the fire in the boiler going out.

There is also available a portable heater working on the same principle. This is made up of two cylindrical tanks joined by circulating pipes, filled with water and heated by immersion heaters. A word of warning here—in soft-water districts, heaters in which the tanks and pipes are made of copper should be used, otherwise trouble with corrosion will be experienced. This type of heater must stand on the path or border, to allow a free air circulation around the heater and so ensure an even distribution of heat throughout the greenhouse.

The same warning regarding positioning applies to the convector heater. This is a cabinet containing a heating element, and is so designed that air enters at the bottom of the cabinet, passes over a heating element, and is discharged at the top, giving a gentle circulation of warmed air all the time.

In comparing the different types of equipment available, it is most important to realize that in every case the output of heat from any particular piece of equipment is fixed by its electrical loading. This is expressed in watts or kilowatts (1000 watts), and for each 1000 watts running for 1 hour (=1kWh., or 1 unit of electricity), 3412 B.Th.U.s are produced. This remains true no matter what type or what make of electrical heating equipment is chosen, there is no question of any one type or any one make being more efficient or more economical than another.

To arrive at the electrical loading required to maintain a given temperature is quite a simple calculation. First work out by the method previously given the number of B.Th.U.s required to maintain the required temperature, and then divide this figure by 3·412; this will give the electrical loading required, expressed in watts.

In the case of the example given on page 43, where it is shown that 13350 B.Th.U.s/Hr. are required to maintain an air temperature of 50°F. in a 12-foot by 8-foot greenhouse against an outside temperature of 20°F., the electrical loading required will be $\frac{13350}{3{\cdot}412}=3913$ watts, and the next larger size of heater should be fitted.

While the capital cost of the installation is the first consideration, the running cost, that recurring charge on our income, is of equal and often of major importance. Unfortunately, due to that unpredictable factor of utilization efficiency, to assess running costs in advance is always difficult, and with solid fuel and even oil installation sometimes impossible. However, to estimate the consumption of electricity is relatively quite a simple matter. It must, however, be remembered that the calculation will give approximate consumption for an *average* winter, and that the actual figure will vary from year to year according to the severity or mildness of the winter. It will be found in practice, however, that, averaged over a five-year period, the forecasted figures will be a very near approximation of the consumption.

The estimated consumption for an average winter heating season, from October 1 to March 31, is arrived at as follows:

The glass area of the greenhouse multiplied by the appropriate figure for the district and temperature taken from the table on page 57.

Returning to our example on page 43, the estimated consumption of electricity for an inside temperature of 50°F. during the heating period October 1 to March 31 in London and the Home Counties would be:

Area of glass, 12 ft. by 8 ft.=96 sq. ft. × 13·9=1335 kWh. or units of electricity.

| *District* | *Inside Temperature Required* | | | |
|---|---|---|---|---|
| | 45° | 50° | 55° | 60° |
| N. Scotland | 9·5 | 18·0 | 27·0 | 36·0 |
| E. Scotland | 8·8 | 17·1 | 26·1 | 35·1 |
| NE. England | 8·4 | 16·3 | 24·9 | 33·9 |
| E. England, Midlands, W. Scotland and Isle of Man | 7·5 | 15·4 | 24·0 | 33·0 |
| London and Home Counties | 6·6 | 13·9 | 22·2 | 31·2 |
| SE. England | 5·6 | 12·8 | 21·3 | 30·3 |
| NW. England, N. Wales and N. Ireland | 5·3 | 12·9 | 21·6 | 30·6 |
| SW. England and S. Wales | 3·2 | 9·5 | 17·4 | 26·7 |

It will be noted that the consumption of electricity depends upon the area of glass, and the inside temperature maintained, and *not* on the loading of the heaters installed. If, for example, heaters to give an inside temperature of 55°F. have been installed, and 50°F. only are required, it is only necessary to set the thermostat to 50°F. The thermostat will switch on the heaters only when necessary to maintain 50°F., and the result will be a shorter running time because of the additional heating capacity. The consumption of electricity will in fact be precisely the same as if heaters only large enough to maintain 50°F. had been installed. Therefore, when planning your installation, allow sufficient heating capacity to deal with your maximum heating requirement, secure in the knowledge that the thermostat will ensure that there is no waste of electricity either when running the house at the maximum temperature or during the periods when the temperatures in the lower ranges are required.

Management of the electrical heating installation is quite simple, in fact the major step towards good management is taken when it is decided to install a *rod* type thermostat to do the good management for you. This, allied to well-chosen electrical heating equipment, installed, as it must be, by a competent electrician, will ensure that the required temperature conditions are automatically provided at all times.

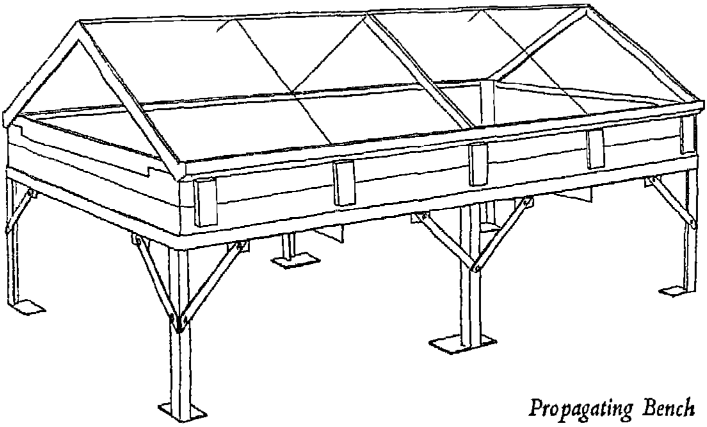
The choice of the operating temperature is also of major importance, particularly bearing in mind the effect on running costs of even 5°F. more temperature than is strictly necessary for good growing. Therefore, to get the best results from the electrical space heating installation at the minimum of costs, it is essential that the gardener should have sufficient faith in his heating installation and thermostat to forgo that extra 5°F., so often added "just in case".

A further service which electricity can provide in the greenhouse is that of controlled root temperature, both in the borders and on the benches, by means of electrical soil-warming equipment. Their use can have a significant effect on running costs, as often the higher air temperatures are only necessary to provide the correct root temperature for the plants. Many plants would be better grown with a lower "head" temperature if only the "toes" could be kept warm by some means. The wise gardener will therefore drop the air temperature in his greenhouse to a comparatively low, and consequently very economic, level, and install electrical soil-warming to provide the essential root temperature.

Two types of electrical soil-warming equipment are available—the transformer low-voltage equipment, and the mains-voltage cable. The transformer low-voltage equipment consists of a warming element of bare galvanized wire energized at low voltage—generally 8 to 12 volts for the small installation—from a transformer, and is suitable for use in borders or on benches. The mains-voltage cables which are energized at full mains voltage—usually 240 volts—are suitable for use on benches where there is no possibility of cultivation or digging.

For borders, the warming wire of the low-voltage equipment is placed direct in the soil at a depth of approximately 9 inches, and on benches either the low-voltage warming wire or the mains-voltage cable is laid on about 2 inches of fine sand and covered by a further 3 inches of sand to form a warm bed on which are placed the boxes, pots or seed pans. When switched on, the wire or cable warms up to approximately 110°F., and the heat is transferred into the soil or sand, and so provides the warm "toes" so essential for most plants.

It often happens that the bulk of the plants in the greenhouse could well do with a low air temperature and even only frost protection, but for the sake of a few plants or seedlings it is necessary to run the general air temperature as high as 50°F. or 55°F., with a corresponding increase in running costs. A considerable saving on running cost, as well as an improvement in growing conditions for all the plants and seedlings, can be made if the propagating bench is enclosed to form a miniature greenhouse and equipped with mains-voltage warming cables to provide a separate air-warming and soil-warming system.



*Propagating Bench*

# *Flowers for the Greenhouse*

By S. A. PEARCE

GROWING PLANTS UNDER GLASS NOT ONLY PROVIDES INTEREST AND MUCH PLEASURE, but is more exacting than other forms of gardening. Under glass, the grower has, or should have, absolute control of his plants and their requirements, but at no time can he afford to neglect them or the greenhouse.

Perhaps the best advice for the beginner is to proceed slowly and not attempt too much at first. So often an endeavour is made to grow too many plants in the space available and overcrowding is one of the main causes of failure that must be avoided. It is only natural to desire variety and try to grow almost every plant that is catalogued or that is seen at a show—it is an error that is common to us all. It is, however, a mistake that can lead to trouble, and it is most important to realize the limitations of a greenhouse. It is useless to attempt to grow plants that require special conditions and a high temperature if only limited heat is available. Another common error is to try to grow plants that require humidity with those needing a dry atmosphere; the result is that neither flourish. To grow a wide and varied collection of greenhouse plants, separate greenhouses or at least compartments are required, together with other essentials. These include sufficient reserve of heating to maintain an adequate temperature during low temperatures out-of-doors, ample ventilation that is easily controlled, and a satisfactory means of shading by roller blinds. Also a supply of water contained in tanks within the house, so that it is about the same as the ground temperature of the house.

Light is essential to all plants, and especially to those grown under glass. It is very necessary to provide ample light, particularly during the winter months, when in most districts it is below the requirements of the plants grown. Frequent washing down of the glass outside is most important and should not be neglected, especially where industrial pollution is bad.

One of the most interesting operations connected with growing plants under glass is their propagation and, perhaps, the greatest satisfaction is to be achieved from raising and growing one's own young stock from seeds or cuttings instead of buying them in from an outside source. It is, however, necessary to have facilities for the job and a propagating frame or case, preferably with bottom heat, should be erected at the warmest end of the greenhouse. The size of the frame must depend on requirements, but it should have glass lights that can be removed or lifted on hinges. It should be partly filled with a mixture of peat-moss fibre and silver sand, and into which cuttings can be inserted or, alternatively, pots containing them can be plunged in peat. Such a propagating frame does, however, require daily attention, and the lights should be opened for an hour at least each morning to admit air and also to remove condensation from the glass.

Cleanliness is essential in the greenhouse. All woodwork, glass and staging should be washed down thoroughly during the winter or early spring, when the house is not so full of plants and there is more time. Use a little insecticide and some soft soap in the water and, if the laps of the glass have collected a lot of grime, they should be cleaned out with a strip of tin or an old celluloid label. The shingle covering of the stages should also be washed or renewed, while the underneath parts, and particularly behind the hot-water pipes, should be clean and free of debris.

Clean receptacles should always be used and pots and pans must be well washed before they are used. Never harbour dirty receptacles and always wash them before storing so that they are ready for use when required. The same remarks apply to seed boxes and hanging baskets, the cleanliness of which is so often overlooked.

Soils and composts play a very important part in the successful cultivation of greenhouse plants and at no time can their quality and preparation be neglected. Fortunately the introduction of the John Innes standardized composts for seed-sowing and potting has simplified matters considerably, especially for the amateur. If desired, these composts may be purchased ready mixed or they may be prepared by the grower to the John Innes formula. Many growers, however, still like to mix up their own special composts for special subjects, and while the standardized composts are excellent, there are certain plants that will thrive better in a compost specially mixed for them.

The operation of watering and damping down is of prime importance, and requires very special attention at certain times of the year. During the winter months, watering and damping must be done with great care. As a general rule, watering should be carried out as early in the day as possible and during winter, not after midday.

Fumigation and spraying of plants with insecticides and fungicides are necessary in the best-managed greenhouses, and it should be remembered that it is better to give an occasional fumigation or spraying even if pests or diseases are not in evidence, rather than to wait until a large infestation is observed. The best method to adopt is to give periodic fumigations or sprayings according to a prepared programme. In this way the plants are best kept in a healthy state and should not be seriously troubled with pests or disease.

Plants growing in pots or other receptacles soon use up the nourishment in their allotted quantities of soil, and need feeding to maintain vigorous and healthy growth coupled with good flowers or crops. Here again, the operation of feeding must be carried out systematically and to a defined plan. Strong fertilizers must be used with care, and for preference all feeding should be with liquid manure. Approved plant foods, when used in a dry state, should be immediately watered in and not left on the surface soil, otherwise burning of the delicate feeding roots near to the surface can occur, with serious consequences.

As mentioned, overcrowding in the greenhouse must be prevented and, with the average greenhouse, it is essential to select and grow only those plants that can be accommodated within the limits of available space. The size of the greenhouse and also frame space is the deciding factor, and to avoid the common error of trying to grow too many plants or, on the other hand, those for which suitable conditions are not available, a decision must be made on the type and quantity of plants to be grown. With most amateurs it is a question of deciding whether to grow:

(*a*) Pot plants for greenhouse and house decoration.
(*b*) Plants for cut flowers.
(*c*) Plants for bedding out and summer display.

There can, of course, be some overlapping, but it must depend on space and when it will be available.

Having decided on the type of plants to be grown, the problem of making a selection will arise. Here, again, the beginner especially will be well advised not to endeavour to attempt too much and proceed slowly at first. The following notes on some of the subjects available and under the group headings as above, will, it is hoped, provide useful information on the various subjects and their culture and also assist the beginner in making a selection.

## POT PLANTS FOR THE GREENHOUSE

Under this heading many subjects could be listed, but in order to avoid repetition, a tabulated list is given at the end of this article.

Although there are various methods of propagation, some of them specialized, the average gardener—and in particular the amateur—is only concerned in most instances with two or three of them. For the most part, the majority of our greenhouse plants can be raised either from seeds, cuttings or by division. It should be noted, however, that other methods of propagation, i.e. by means of layers, grafting, budding, offsets, suckers, leaf-cuttings and root-cuttings, can be employed and are sometimes necessary for certain plants.

Raising plants from seeds is perhaps the best and most popular method, especially where space is limited, for there is not the worry of over-wintering stock plants. However, there are many beautiful greenhouse plants that cannot be perpetuated true to type or colour from seeds, and vegetative means of increase have to be employed. The winter-flowering begonias and also other fibrous-rooted species and varieties are examples, while the same may be said of coleus, fuchsias and the regal and zonal pelargoniums.

In dealing with seeds of greenhouse plants it must be remembered that they are for the most part rather small, and therefore need greater care in sowing than perhaps many other subjects where the seeds can be sown out-of-doors. The importance of the seed compost and clean receptacles has already been emphasized, but it should be realized that the pots, pans or boxes must be well drained and filled with compost to within a half-inch of the rim, so that sufficient space is left for a covering of soil after the seeds are sown. Some seeds, e.g. those of begonia, gloxinia, calceolaria and streptocarpus, are almost dust-like, and with seeds of this type no covering is required, except possibly a fine sprinkling of silver sand. One of the most important points to bear in mind is the thin sowing of seeds. Thick sowing is not only wasteful but conducive to failure due to the fact that, being overcrowded, the seedlings become weak and drawn and are liable to damp off. With small seeds, it is advisable to mix a little fine sand or dry soil with the seeds in the packet to aid even distribution. Another method is to place a quantity of the seed on a piece of paper and then, holding it over the soil, gently tap the paper to scatter the seeds. No hard and fast rules can be laid down regarding the depth of sowing, but with all seeds except the very fine ones, they should be covered to about their own depth.

Many of our greenhouse plants are easily propagated by cuttings and generally these can be inserted at almost any time when available from early spring to late summer. Usually, a plentiful supply of cuttings of most of the subjects propagated vegetatively can be obtained from one or two stock plants. These should be selected for form and trueness to type, and after flowering they should be partly cut back and, if regularly syringed, should soon produce plenty of young shoots suitable for cuttings. Most subjects will root readily in a mixture of loam and peat-moss with plenty of sharp sand added. Generally, the cuttings should be made about 3 inches long, taking off the basal leaves and cutting cleanly just below a node or joint. Firm insertion is essential, taking care to get the cutting secure at its base. Except when large quantities of cuttings are to be propagated, pots are the best receptacles and, if the cuttings are inserted around the inner edge of the pot, they will be found to root more easily. After insertion and a thorough watering, the cuttings should be placed in a propagating case or frame, keeping the lights or glass over them and only opening the case to allow condensation to be removed each morning and to give a light spray once or twice a day according to weather conditions and the time of year. Generally, the majority of cuttings will be rooted in three weeks, and they can then be gradually inured to more airy conditions and placed on a staging near to the glass. After a week they can be potted singly, but care should be exercised not to pot off too early and before there is a good root action.

Propagation by division of the root stock can be used where the subject forms a number of basal stems. Ferns are a good example. The operation should be carried out just after new growth commences, and it does provide an easy and effective way of increasing the stock.

## CARNATIONS

Generally, these are specialized crops and the grower devotes much time and trouble to their culture to produce high-quality flowers for cut purposes and also for display as flowering plants. For the amateur who wishes to grow a batch of varieties of perpetual carnations, the best method is pot culture rather than to attempt the commercial method of growing in beds. If grown in pots the plants can be moved to allow space for other plants when required. The carnations can also be given outdoor summer quarters prior to housing them to flower from October onwards, and so provide greenhouse space for other subjects during the summer months. Carnations are propagated by cuttings inserted at almost any time from October to January. The cuttings should be made from clean, strong young growth preferably taken from the middle portions of the parent plant and inserted either singly or several together in pots of sand, in which they should root without difficulty if placed in a close frame. When rooted and commencing to grow, pot off the young plants singly, or if rooted singly in thumb pots, into 3½-inch pots, using John Innes potting compost, or a similar mixture. Grow on the young plants without check and provide plenty of light to encourage sturdy growth. Ventilate freely on all favourable occasions, remembering that it does not pay to coddle the plants at any time, and especially when they are growing freely in their pots. Pot on as required until they occupy 7-inch receptacles which are suitable for the final potting.

It is necessary to stop the plants by removing the central or main shoot to ensure bushy plants, but it should not be done until side-shoots are forming. Young plants that do not break readily should be thrown out, for they seldom make satisfactory plants, even with the aid of stopping. Subsequent treatment will consist of regular syringing and careful watering of the plants at all times, while a periodic spraying with nicotine insecticide or fumigation should be given to prevent aphis and thrips from making their appearance. Further stopping of the growth will depend on the variety; generally a second stopping of the main growths is advisable, but it should be done gradually—one or two growths at a time so that a check to the plant is avoided.

Once the plants are well-rooted in their final pots, gentle feeding may commence, but heavy feeding should be delayed until the flowering period commences. Disbudding must be a routine job from the time the first flowering shoots appear, but it should not be attempted until the side-shoots are large enough to be removed easily and without fear of damage to the main stem and bud. Summer shading is generally unnecessary, except possibly at the end of a house or at the side where the sun may strike directly on to the base of the plants. Shading, if used, should not be of a permanent type and should be put on or removed according to the heat of the sun.

### CHRYSANTHEMUMS

To some extent, chrysanthemums require much the same treatment as carnations, the season of propagation, early growth under glass and the subsequent treatment for flowering being similar, but the flowering season is shorter and the plants cannot be grown on for a second year in the same way as carnations.

Where it is intended to grow chrysanthemums, it should be remembered that they do require priority in the greenhouse and frames for a good deal of their growth, but as they occupy outdoor quarters from May to mid-September, the greenhouse and frame space is vacant for other plants for this period.

Propagation from cuttings commences in November and may continue, according to requirements and the type grown, until February or even early March. The cuttings obtained from the old plants or stools should be made from good clean basal growths, about 3 inches long, and be inserted either singly in small pots or several together in 3½-inch pots, using a compost containing plenty of sharp sand. They will root in about three weeks in a close-propagating frame and, after being inured to more light and air, the pots can be moved to a shelf or staging well up to the light to encourage sturdy growth. If several cuttings are rooted together, they should be potted singly into 3-inch pots as soon as the new growth is observed. A light syringing overhead when the weather is bright is very beneficial, while an occasional spraying with nicotine insecticide will prevent the appearance of aphis and other pests.

The second repotting will be into 5-inch pots, and when established in these receptacles, the plants should be moved to cool or slightly heated frames where they should be given plenty of air on all favourable occasions. The cooler the treatment within reason the better and stronger will be the growth. About mid-May, potting into the final receptacles can begin, usually into 9- or

10-inch pots, and using a good rich compost. It is impossible to lay down hard and fast rules regarding this compost and most growers mix according to their own pet recipe. The John Innes potting compost can be used if desired, and will be found to give excellent results. Pot the plants firmly and leave sufficient space at the top for watering and later on a top-dressing. Each plant should be given a stake and securely tied to it. After potting, the plants should be placed in a sheltered spot and fairly close together for about a fortnight (longer if the weather is rough and cold), to enable them to become established before being placed in their summer quarters. For summer, choose an open sunny position with shelter from the south-west, but not near to, or under, trees. The side of the garden path is quite good if open ground is not available. Place the plants in rows with a base of ashes or on boards or slates, and provide a wire stretched between strong posts, and to which the stakes can be tied securely to prevent the plants being blown over during rough weather.

Careful watering is essential at all times, and especially after the final potting, but an overhead spraying and damping around the plants to provide a moist growing atmosphere is very beneficial and this should be regularly attended to. A close watch must be maintained for pests and a spraying programme practised as a means of prevention or control.

Chrysanthemums are gross feeders, and to obtain the best results generous feeding within certain limits is necessary. It should take the form of applications of liquid manure during the early stages, leaving top-dressings of an approved dry fertilizer until after the buds are formed. Stopping and disbudding is most important and here again hard and fast rules cannot be applied, because so much depends on the variety and also the purpose for which the plants are grown. Generally, the directions given in a nurseryman's catalogue can be safely followed. Usually the time for taking or selecting the buds for the October and later flowering varieties is August and September; earlier buds usually do not open freely and are not of much use.

The time for housing the plants will naturally depend on weather conditions, but generally it is not safe to leave the plants out-of-doors after the end of September.

### BULBS FOR FORCING

With the aid of the greenhouse and frames, the growing and forcing of the various bulbous subjects, daffodils, tulips, hyacinths, etc., in successional batches for the indoor decoration of the house, is rendered comparatively easy. Perhaps the most important point to remember is that a good and ample root action is necessary before any attempt is made to force the top-growth. This can best be achieved by getting the bulbs potted early—in August—and placed under a covering of peat-moss, sand or old ashes. Here the pots should remain until the bulbs have made good root action and top-growth is commencing, after which the pots can be removed to a cold frame and shaded from strong light until the new growth is green. The pots or other receptacles can be taken into the greenhouse in successional batches, according to requirements, and gradually forced. It is a great mistake to subject the bulbs to a high temperature immediately, and the process should always be in stages. It should also be remembered that all forcing bulbs require plenty of water at the roots and at no time should the soil be allowed to dry out. This is especially important during the actual forcing period.

## BEDDING PLANTS

Plants for summer display only occupy the greenhouse and frames for a limited period, the length of time depending on the type of plants grown. Those of perennial habit and demanding winter protection require far more use of the greenhouse than when the subjects used for summer displays are raised annually from seeds. For the average garden, propagation of bedding plants will commence during February and continue until April, the various subjects being catered for according to the time of growth needed before flowering. For the most part, the plants are grown in pots or boxes, the latter being extensively used for the majority of the half-hardy annuals raised from seeds, while other subjects of perennial habit raised from autumn or spring cuttings are usually grown in pots, or planted out direct into prepared beds of soil in frames.

Normally, the growing of plants for bedding out and summer display does not present much difficulty. All seeds should be sown as thinly as possible and the seedlings must not be allowed to become drawn before they are pricked out. Cool treatment once the young plants are established will ensure the best results, while a watch must be maintained to prevent insect attacks or diseases.

For the keen gardener who is not too restricted in space, a wide selection of greenhouse plants is available, from which it is easy to make a selection of subjects that can be grown and flowered in their season. The following tabulated list is prepared for the reader's reference.

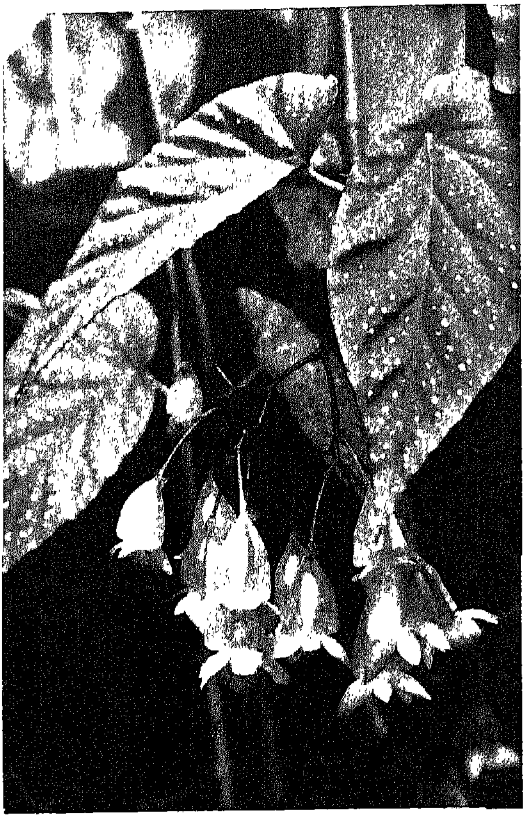
| *Name* | *Height* | *Time of Flowering* | *Colour* | *Propagate by* |
|---|---|---|---|---|
| Abutilon in variety | 2–3 ft. | Summer | Red, yellow, orange and white | Cuttings or seeds |
| Achimenes (various) | 1–2 ft. | Summer | Various | Rhizomes, cuttings or seeds |

## FLOWERS FOR THE GREENHOUSE

| *Name* | *Height* | *Time of Flowering* | *Colour* | *Propagate by* |
|---|---|---|---|---|
| Auricula in variety | 6–9 in. | Spring | Various | Seeds |
| Azalea indica (Indian Azalea) | 2 ft. | Spring | Various | Cuttings |
| Begonias in variety | 1–4 ft. | All seasons | Various | Seeds or cuttings |
| Bouvardia (various) | 2–3 ft. | Autumn and winter | White, pink and scarlet | Cuttings |
| Browallia speciosa major | 1½–2 ft. | Autumn, spring and summer | Royal blue | Seeds or cuttings |
| Calceolaria (various) | 1–2 ft. | Spring | Mixed | Seeds and cuttings |
| Campanula isophylla | Trailing | Summer | Blue | Cuttings |
| ,, ,, alba | ,, | ,, | White | ,, |
| ,, pyramidalis | 4–6 ft. | Summer | Blue | Seeds |
| ,, ,, alba | 4–6 ft. | ,, | White | ,, |
| Canna in variety | 2–3 ft. | Summer | Various | Seeds or division |
| Celosia plumosa | 1½–2 ft. | Summer | Red or yellow shades | Seeds |
| Celsia Arcturus | 1–2 ft. | Spring or summer | Yellow | Seeds |
| Chorizema cordata | 3–6 ft. | Spring | Red and yellow | Seeds or cuttings |
| Cineraria in variety | 1–3 ft. | Spring | Various | Seeds |
| Clerodendron fallax | 2–3 ft. | Summer | Scarlet | Seeds |
| Clivia miniata | 3 ft. | Spring | Orange | Seeds or division |
| Cyclamen in variety | 12 in. | Spring | Mixed | Seeds |
| Epacris in variety | 2–3 ft. | Spring | Various | Seeds or cuttings |
| Erica (various) | 1–3 ft. | Spring | Pink and white | Seeds or cuttings |
| Eupatorium atrorubens | 2–3 ft. | Winter & spring | Mauve | Cuttings |
| ,, macrophyllum | 3–4 ft. | ,, ,, | ,, | ,, |
| Euphorbia pulcherrima | 3–5 ft. | Winter & spring | Scarlet bracts | Cuttings |
| ,, fulgens | 3–4 ft. | ,, ,, | Orange-scarlet | ,, |
| Exacum affine | 12 in. | Spring | Pale mauve | Seeds |
| Francoa ramosa | 2–3 ft. | Spring | White | Seeds |
| ,, appendiculata | 2–3 ft. | ,, | Red and white | ,, |
| Freesia in variety | 1–1½ ft. | Spring | Mixed | Seeds or bulbils |
| Fuchsia in variety | 1–5 ft. | Summer | Various | Cuttings |
| Gardenia florida | 2–3 ft. | Spring and summer | White | Cuttings |
| Genista (Cytisus) fragrans | 2 ft. | Spring | Yellow | Cuttings |
| Gesnera cardinalis | 1–1½ ft. | Summer | Scarlet | Seeds |
| Gloxinia in variety | 12 in. | Summer | Various | Seeds |
| Gloriosa Rothschildiana | 6 ft. or more | Summer | Scarlet and yellow | Seeds |
| ,, superba | ,, ,, ,, | ,, | Scarlet and yellow | ,, |
| Humea elegans | 5–6 ft. | Summer | Reddish pink | Seeds |
| Hydrangea in variety | 1–3 ft. | Summer | Various | Cuttings |
| Impatiens Holstii | 1–2 ft. | Summer | Scarlet | Cuttings |

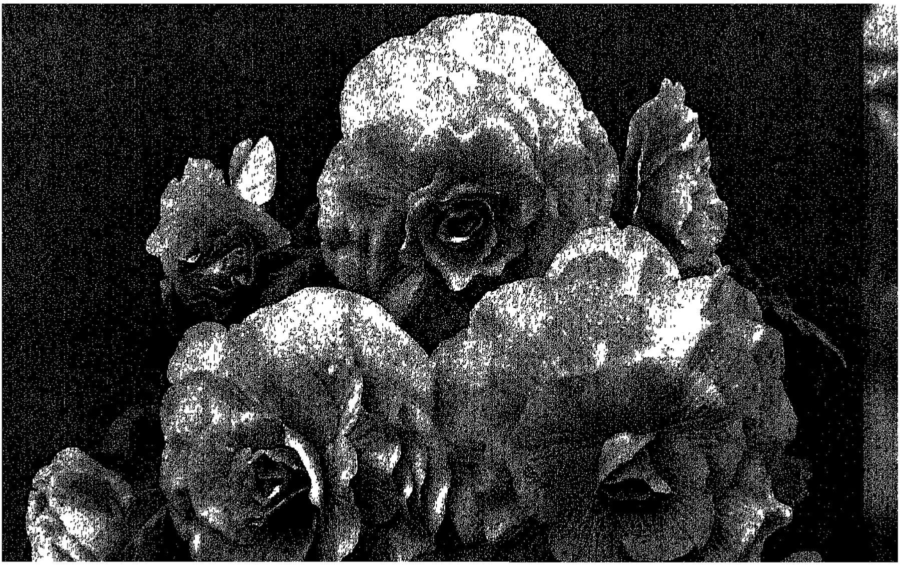
| *Name* | *Height* | *Time of Flowering* | *Colour* | *Propagate by* |
|---|---|---|---|---|
| Impatiens Sultani | 1–2 ft. | Summer and autumn | Pink to red | Seeds or cuttings |
| Ipomoea (various) | Climbers | Spring and summer | Various | Seeds |
| Isoloma hirsuta | 1–2 ft. | Spring and summer | Scarlet | Seeds or cuttings |
| Jacobinia carnea and varieties | 2–3 ft. | Summer | Pink | Cuttings |
| „ chrysostephana | 2–2½ ft. | Spring | Yellow | Cuttings |
| Kalanchoe Blossfeldiana | 1–2 ft. | Summer and autumn | Scarlet | Seeds or cuttings |
| Lachenalia in variety | 12 in. | Spring | Yellow | Bulbils |
| Lantana in variety | 1–1½ ft. | Summer | Mixed | Seeds or cuttings |
| Lapageria rosea | Climber | Spring | Rosy pink | Seeds or cuttings |
| Manettia inflata | Climber | Spring and summer | Red and yellow | Cuttings |
| Mitriostigma axillare | 1–2 ft. | Spring | White | Cuttings |
| Moschosma riparium | 2–3 ft. | Winter | White | Cuttings |
| Naegelia (Gesnera) in variety | 2–3 ft. | Summer | Orange | Seeds or cuttings |
| Nerium Oleander | 4–6 ft. | Spring and summer | Pink | Cuttings |
| Pelargonium (and Geranium) | 1–3 ft. | Winter & spring | Various | Cuttings |
| Primula in variety | 12–15 in. | „ „ | Mixed | Seeds |
| Rehmannia angulata | 2–5 ft. | Summer | Pink | Seeds or cuttings |
| Saintpaulia ionantha | 6 in. | Spring and summer | Blue shades | Seeds or leaf cuttings |
| Schizanthus in variety | 12 in. | Summer | Mixed | Seeds |
| Streptocarpus (various) | 1–3 ft. | Spring | Mixed | Seeds |
| Torenia Fournieri | 12–15 in. | Summer | Blue and yellow | Seeds |
| Trachelium caeruleum | 1–2 ft. | Summer | Blue | Seeds |

In addition to the subjects mentioned in the above list, there are many bulbous plants and also various exotic plants grown for their foliage characters more than for their flowers. These and the various larger growing climbing plants may all be used for the embellishment of the greenhouse or conservatory where space and conditions of culture are available.



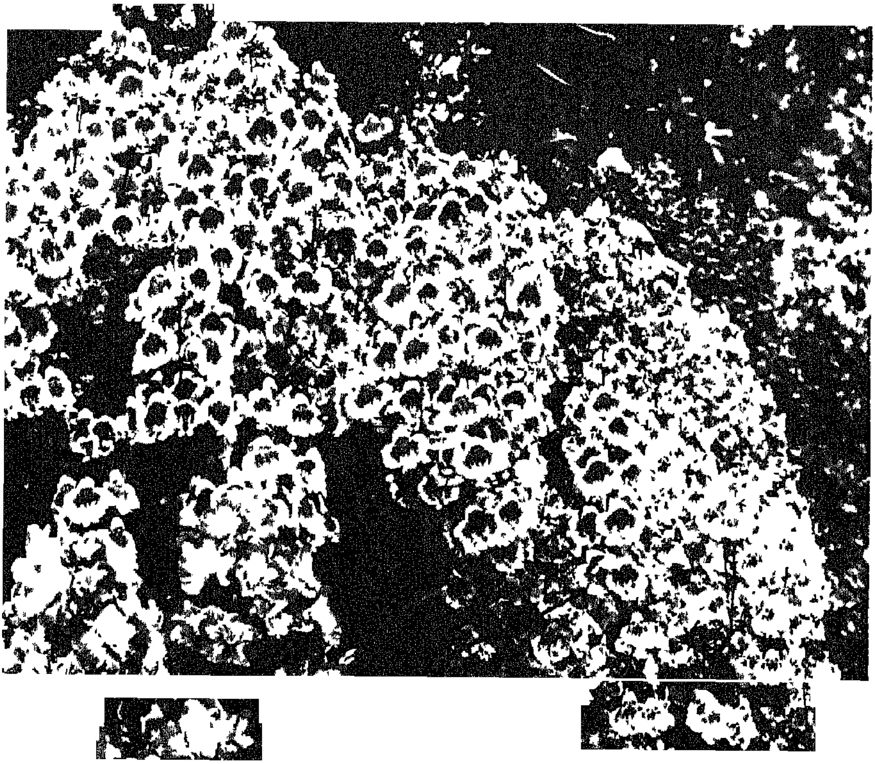
BEGONIA MACULATA
*With its white-spotted leaves and rose-coloured flowers, this Brazilian species provides a lengthy and colourful display* ⇦

BEGONIA CLARISSA HUTCHINSON
*One of the best of the tuberous double-flowered varieties, the beautifully formed blossoms are bright salmon* ⇩



BEGONIA RHAPSODY
*Another excellent variety with large well-formed flowers that are a delightful shade of salmon pink* ⇨

BEGONIA METALLICA
*One of the best of the fibrous-rooted species for pot culture. The leaves are an attractive shade of green with a metallic lustre* ⇩

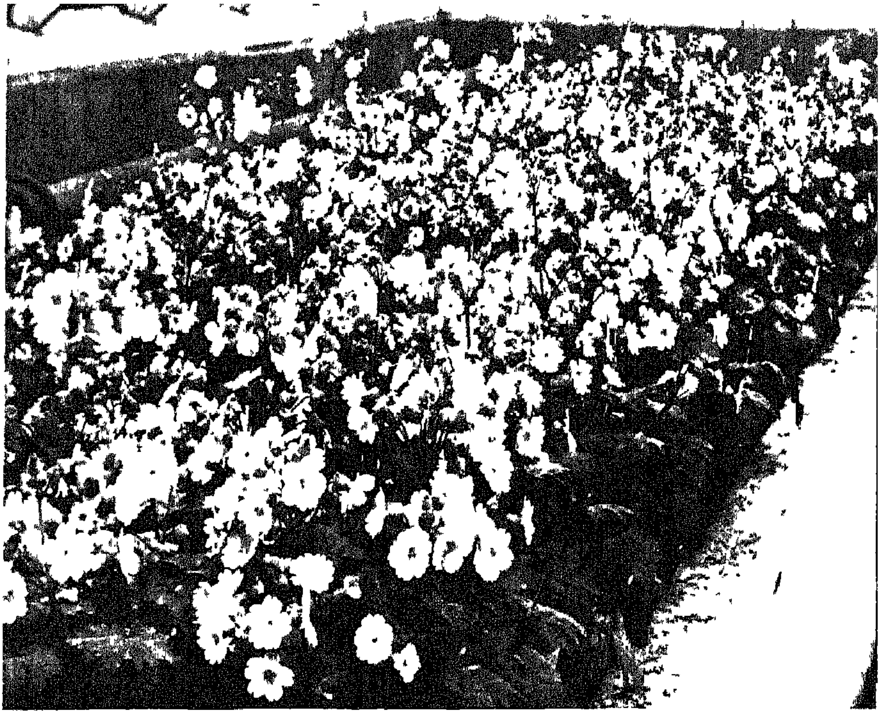


SCHIZANTHUS

*There are a number of excellent strains of this beautiful subject that provide a feast of colour when in flower*

CALCEOLARIA LARGE-FLOWERED PERFECTION

*For profusion of flower and diversity of colour, these Calceolarias are unsurpassed for a spring display*



PRIMULA STELLATA

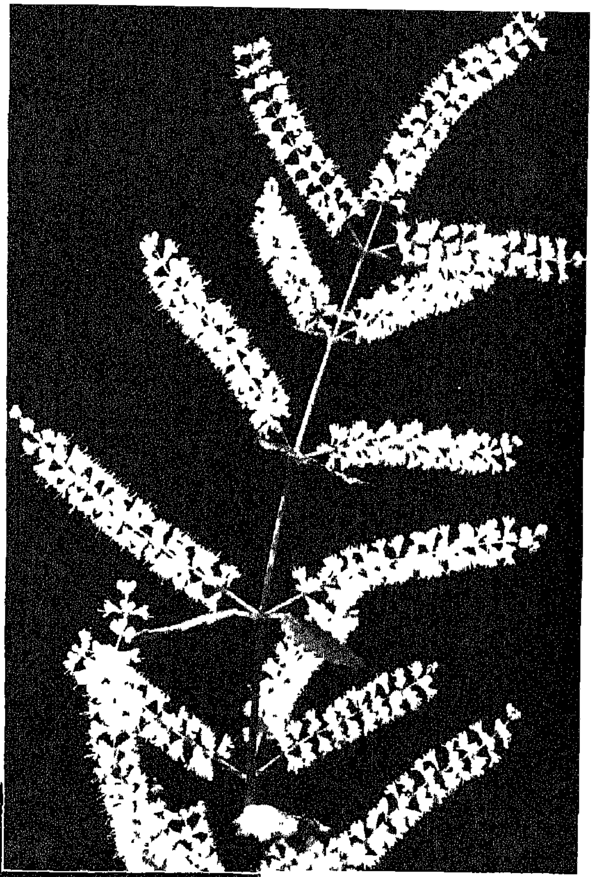
*Of the various greenhouse Primulas, the Stellata or Star types provide a fine winter display and there is a good range of colours*

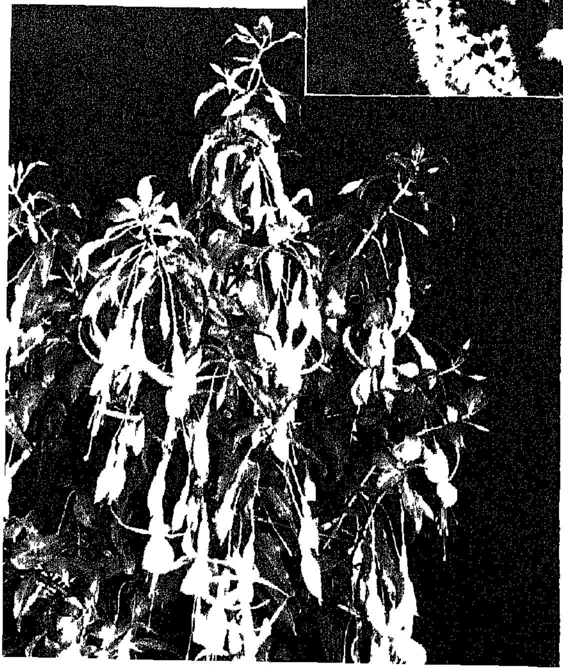
A GOOD GREENHOUSE DISPLAY

*Well-grown plants of the Perfection type of Calceolaria and also the smaller-flowered* C. Clibranii, *together with Hippeastrums, provide a blaze of colour*

MOSCHOSMA RIPARIUM

*This South African plant produces its spikes of white flowers during the winter months Propagate from cuttings and grow under cool conditions* ⇨

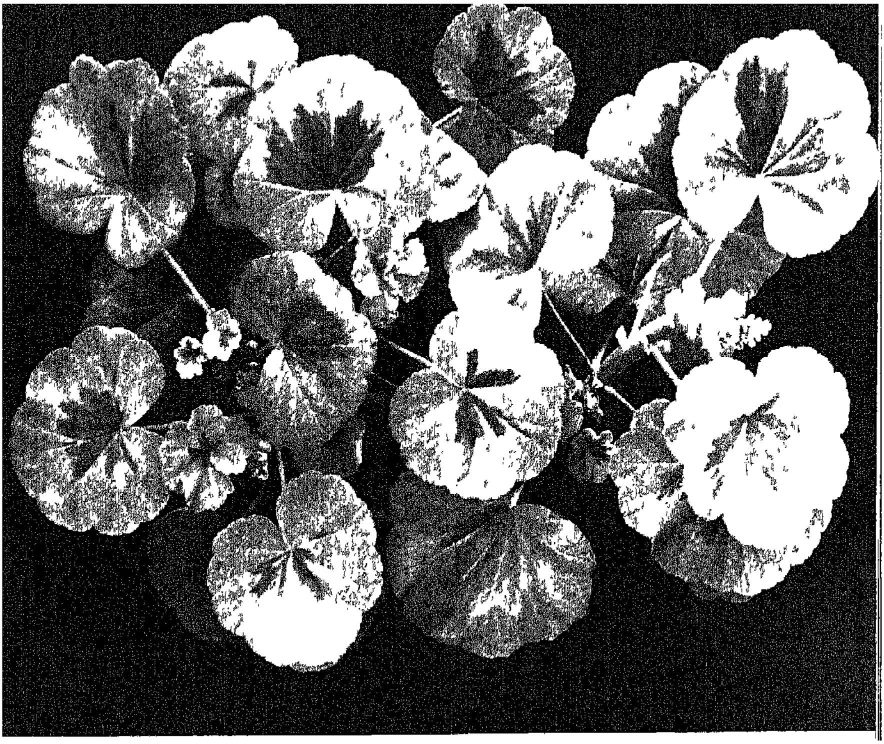




FUCHSIA MELODY

*One of the many excellent varieties, the value of which cannot be over-estimated for the summer embellishment of the greenhouse*

⇦

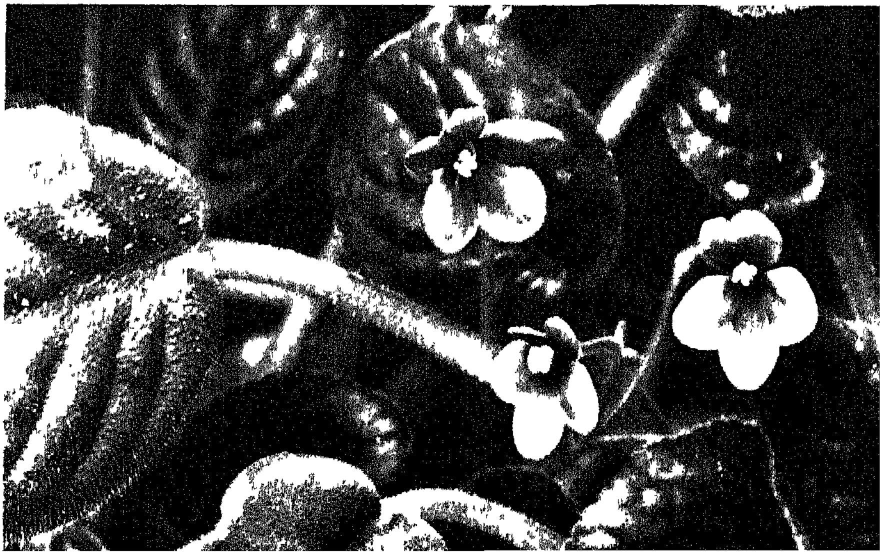


PELARGONIUM CRYSTAL PALACE GEM

*Grown chiefly for its ornamental foliage, this variety and several others are useful for associating with other plants*

SAINTPAULIA IONANTHA

*This charming plant, commonly called the "African Violet", will flower almost continually and may be readily propagated from seeds or leaf-cuttings*



CYCLAMEN PERSICUM

*The type species with its smaller white flowers with crimson base is very pretty and the flowers, unlike the modern forms, are very fragrant*

⇦

CYCLAMEN BATH PINK

*Few if any of our greenhouse plants provide such a lengthy display as do the modern varieties of the large-flowered Cyclamens* ⇩

FUCHSIA BALLET GIRL

*One of the best of the large-flowered double varieties that are ideal for the greenhouse or for indoor room decoration* ⇨

GARDENIA FLORIDA

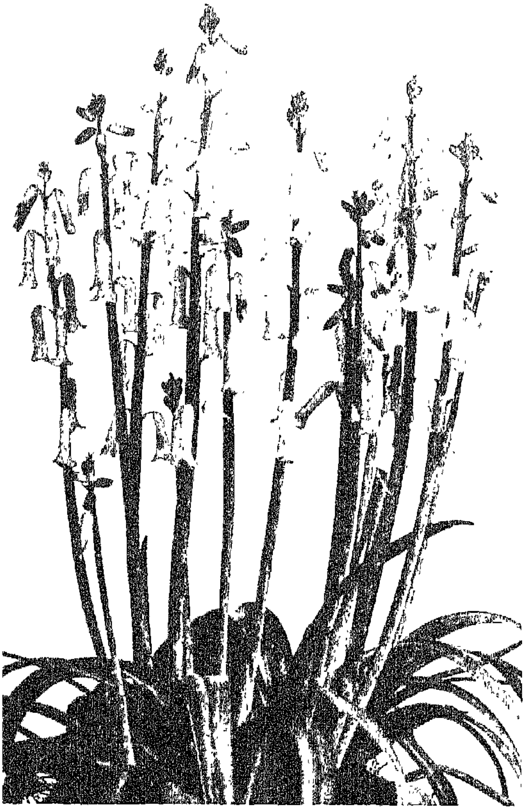
*The beautiful waxy-white flowers of this exotic plant are strongly scented and very useful for buttonholes and sprays* ⇩

EUPHORBIA PULCHERRIMA

*The "Poinsettia" is grown for the brilliant colouring of its bracts or floral leaves The true flowers in the centre are insignificant*

STREPTOCARPUS MERTON BLUE

*This beautiful plant, with its large violet-blue trumpet-shaped flowers with a yellow throat, is one of the loveliest of the hybrid Streptocarpus*



LACHENALIA BURNHAM GOLD

*A lovely variety of the Cape Cowslip. This and other varieties, together with the species* L. Nelsonii, *are most useful for spring flowering*

⇦

CINERARIA MULTIFLORA NANA

*The compact habit and freedom of flowering of this form of Cineraria make it the ideal for the small greenhouse. It may be had in a number of shades of colour* ⇩

GESNERA ORANGE KING

*With its attractive orange flowers and bronzy leaves, this is one of the most showy of warm greenhouse plants*

EUPATORIUM PURPUSII

*This Californian species is rather loose in its habit, but bears its sweetly scented flowers in great profusion and over a long period*

## GLOXINIA DUCHESS OF YORK

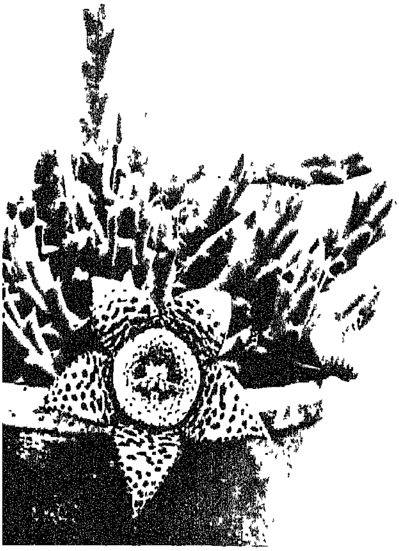
*A very beautiful variety of Gloxinia that breeds true to colour from seed. The large flowers are rich blue banded with white*

⇨

RICHARDIA AFRICANA

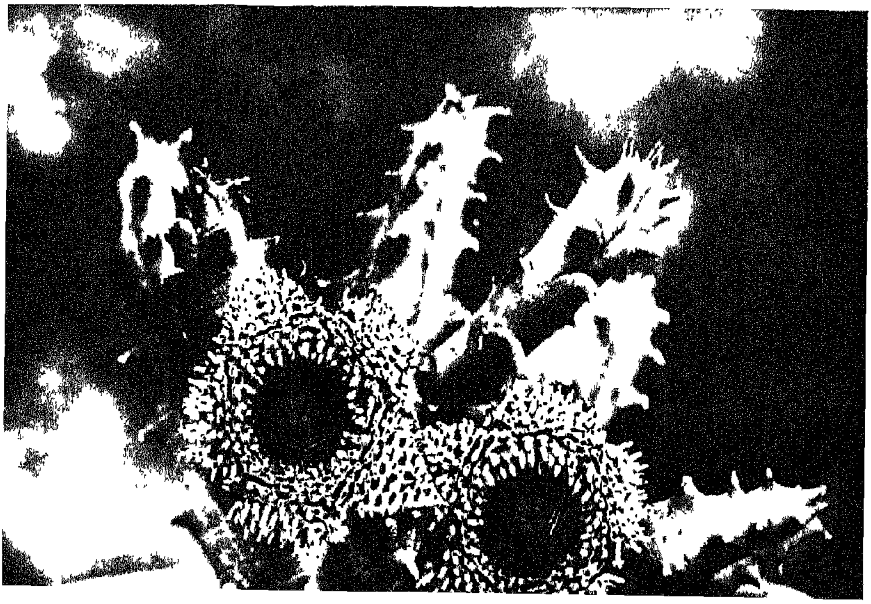
*One of the best of our greenhouse*

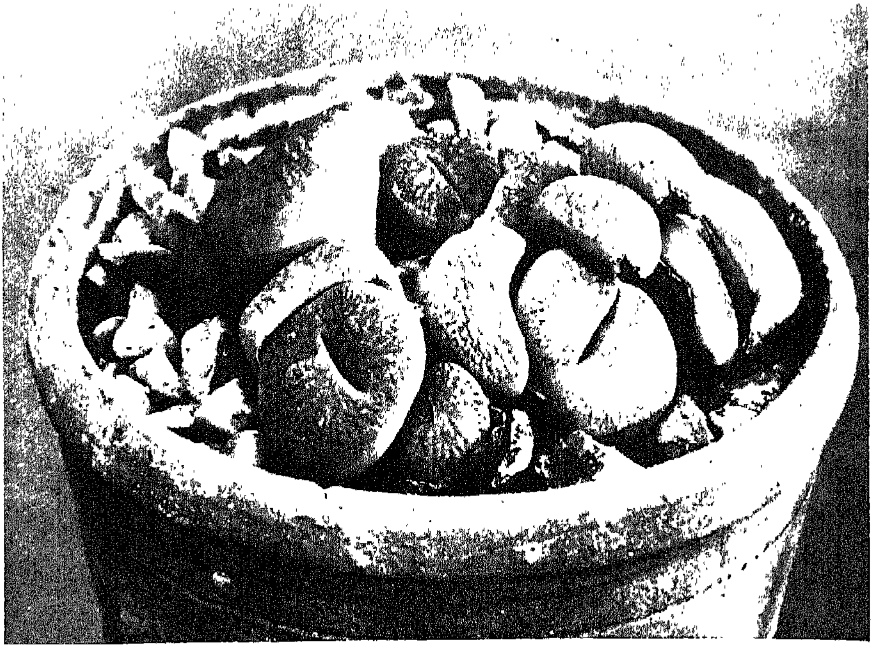
*An epiphytic plant,* Epiphyllum oxypetalum *will flower freely when it reaches maturity. A native of tropical America, it requires more heat and moisture than the ordinary cacti*



*This is one of the commonest of the Stapeliads. There are numerous forms of* Stapelia variegata. *It flowers freely in late summer, and can be successfully grown in a sunny window in a warm room*

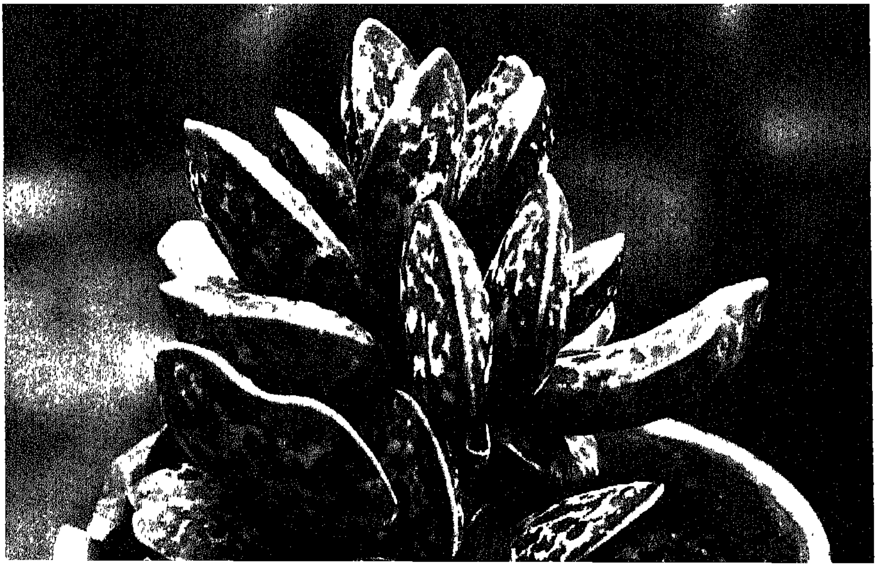
*This is probably one of the strangest and most fascinating of the Stapeliads, with its curious, bristly flowers.* Heurnia hystrix, *a native of Natal, like the true Stapelias requires very little water during the winter*

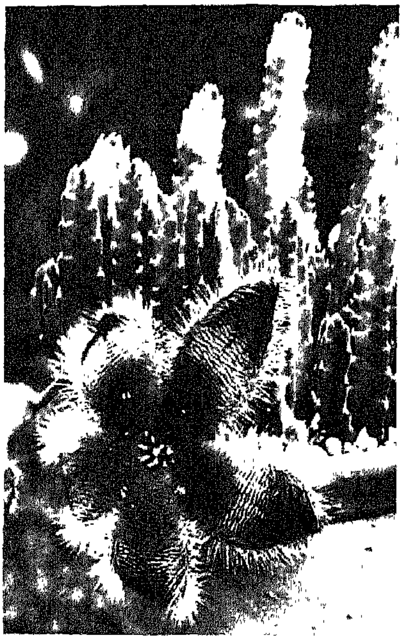




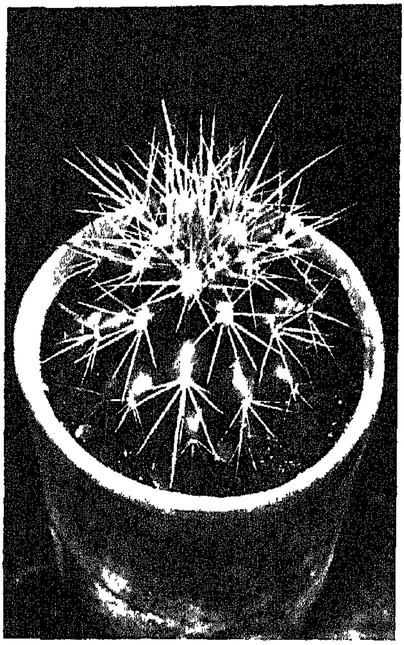
*These small stemless plants grow in very dry regions in South Africa, and resemble pebbles in appearance. They can be effectively grown in well-drained pans of light, sandy soil with pebbles on the surface as shown in the illustration of* Lithops Lesliei. *The flowers of this plant are golden yellow, produced in late summer*

Adromischus maculatus *is a most attractive dwarf South African succulent plant with thick, fleshy leaves which are heavily flecked with reddish brown, giving them a marbled effect*



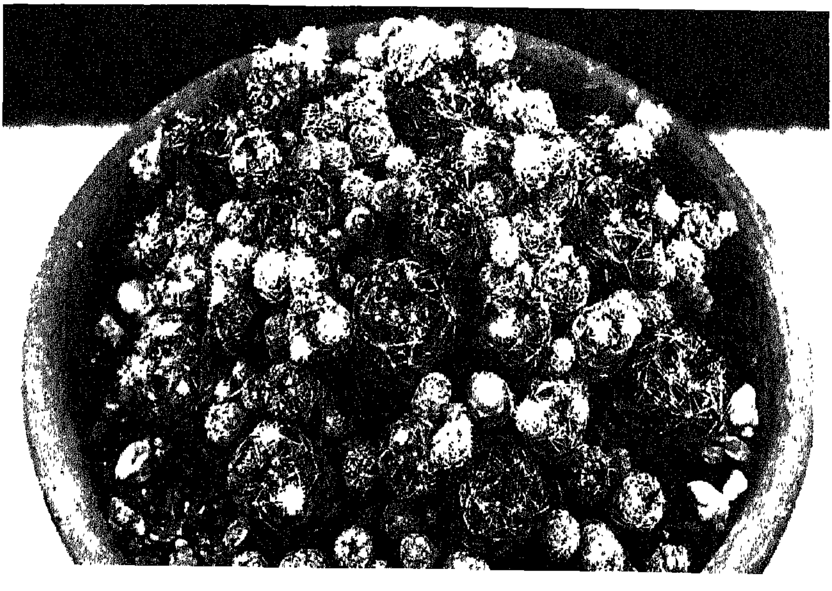


*This succulent plant,* Stapelia hirsuta, *has slender, erect fleshy stems, and attractive blood-red flowers. It is easily grown provided it is not over-watered during the winter*



Mammillaria camptotricha *is a native of Mexico; it likes abundant sunshine and is easy to cultivate. The pale yellow spines are very ornamental*

*This cactus plant is very easy to cultivate, it forms numerous offsets which drop off at the least touch and soon root.* Mammillaria gracilis, *with its radiating, star-like clusters of small white spines, is very elegant when well grown in a light, sunny position*



# *Fruits for the Greenhouse*

### By H. PARSONS

POSSIBLY NO OTHER FORM OF GROWING UNDER GLASS WILL AFFORD THE GROWER more interest, give a greater degree of satisfaction or prove a greater attraction to the majority of visitors, than the perfection of a really well-grown crop of dessert fruits, be it the humble strawberry, luscious grapes or an imposing bunch of bananas. The mention of the latter at once conjures up thoughts of hot houses and the prohibitive cost of hard fuel as well as lofty greenhouses, but as will be seen later on, the production of an occasional bunch of ripe bananas is well within the limits of the enthusiastic gardener with a moderately high greenhouse, sufficiently heated to produce tender greenhouse plants the year through. Those having no form of artificial heating in their greenhouse need have no qualms about fruit-growing; apricots and cherries are never really happy when subjected to artificial heat, but thrive and yield magnificent crops in the cold greenhouse, while all the hardy fruits, such as plums, pears, apples, peaches, nectarines, figs and strawberries, can be grown to perfection. Nor does this list exhaust the kinds of fruits which may be successfully grown. Certain varieties of grapes may also be grown without artificial heat.

Many amateur gardeners, however, like to use their greenhouses for various other purposes. There is no better house for this purpose than the heated vinery-cum-fig house, provided the grower does not lose sight of the growing conditions required by the permanent fruiting subjects.

Of wide appeal is the cold orchard house; it may have a portion of or even all its trees planted into the floor of the house, but it is, on the whole, better to grow all the trees in large pots, tubs or even boxes.

The advantages of having the trees in pots are that after the crops are cleared the trees may be moved outside, where they are much more easily kept free of insect pests and the wood ripens up so much better.

While the house is free of fruit trees it may be used to house mid-season chrysanthemums or some other autumn crop. The best type of house for this form of fruit-growing is the span type with ends north and south; it should preferably be 10 feet high at the ridge and not less than 5 feet at the eaves.

A house 15 feet wide will accommodate four rows of trees with a central path, having two staggered rows on each side. Those rows next the central path may be taller than the second rows and, although the pyramid form of tree is attractive, the bush head on a 2½-foot leg or standard is the easiest to train.

The two other rows should be short bush or dwarf pyramids to permit sufficient head room, it being difficult to grow the trees cleanly if there is insufficient space between the growth tips and the glass. Length of house will determine the number of trees to be grown, of course.

A question often asked is how many kinds of fruit trees may be grown together in one section; some gardeners are very successful in growing many kinds together, but they are in the minority and snags in growing do occur when kinds are mixed indiscriminately.

Peaches and nectarines, for instance, require daily hosing or syringing during favourable weather, except when in flower or when carrying ripening fruits. The same applies to cherries, but as cherries ripen their fruits much earlier and atmospheric moisture must be greatly reduced the moment they commence to colour, or cracking of the fruits will certainly occur, it will be seen that the peach-cherry combination has its problems.

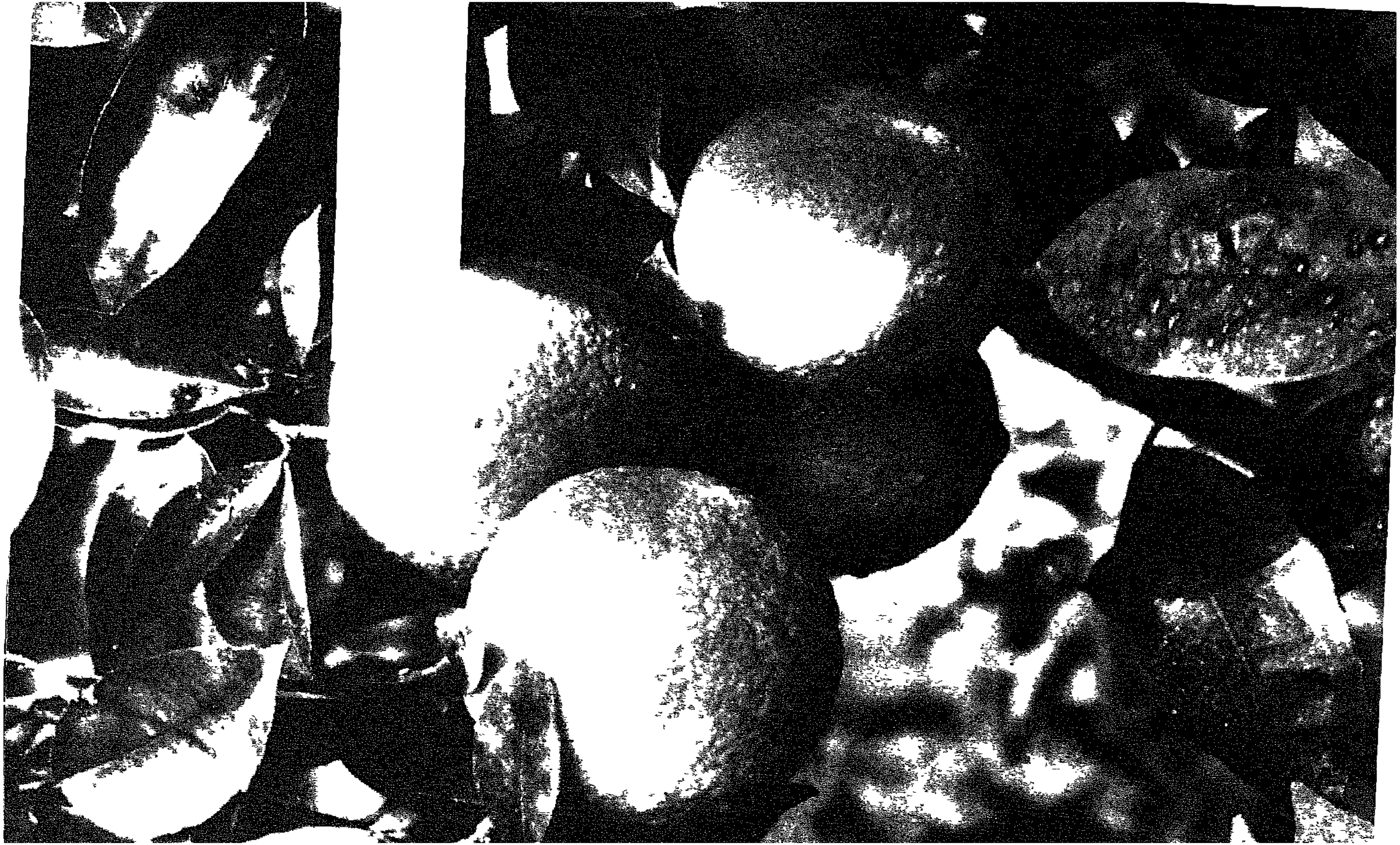
Plums associate very well with cherries, although their fruits ripen later, and by the time the cherries commence to colour, the syringe must be kept off the plums if the beautiful dense bloom on their fruits is to be preserved.

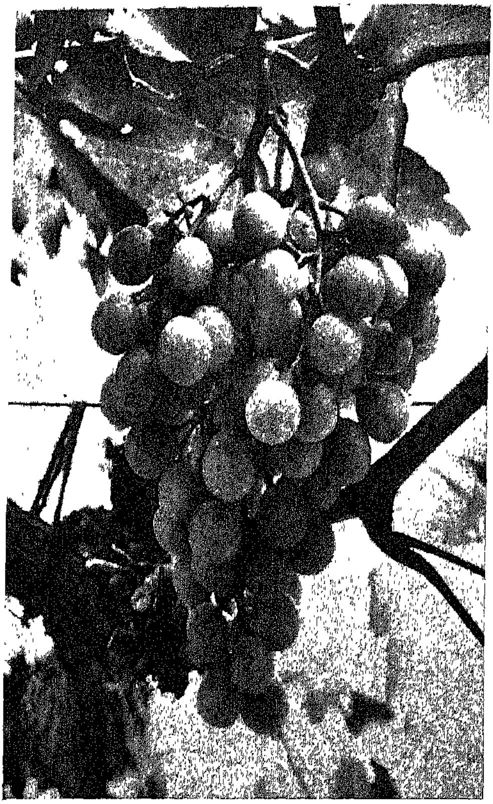
Apricots must not be subjected to too much syringing or to a close, moist atmosphere, otherwise the leaves and fruits are liable to become disfigured by spotting and there is a very definite risk of the flowers and fruits dropping off before the latter reach the stoning period.

Pears and apples fit in very well with plums, cherries and apricots, although it was common in the past to grow these in a separate compartment from the stone fruits. Figs are very accommodating and may be grown successfully with peaches, vines or with the plums and pears. Vines are best grown separately or with figs or newberries on the back wall of a lean-to or three-quarter span vinery. All of these should preferably be planted into the floor or border of the house, when they will crop much more heavily than when pot grown.

Strawberries in pots show quick results and present little difficulty in growing provided they are in no way neglected. Home-grown or purchased runners should be obtained in July or very early in August and at once potted into their fruiting pots of 6-inch size.

Pot firmly, leaving the crown well down in the pot, say, one clear inch from the soil level to the top of the pot; John Innes Potting Compost No. 2 is ideal for this purpose. After potting, the plants are best stood 6 inches from pot to pot each way, on an ash base in the full sun and kept watered, fed, weeded and de-runnered until mid-October, when the pots are plunged to their rims beneath the shelter of frame lights, but fully ventilated on all possible occasions. January





GRAPE BLACK HAMBURGH

*The aristocrat of black grapes. Well-thinned bunches produce large berries*

⇦

MELONS

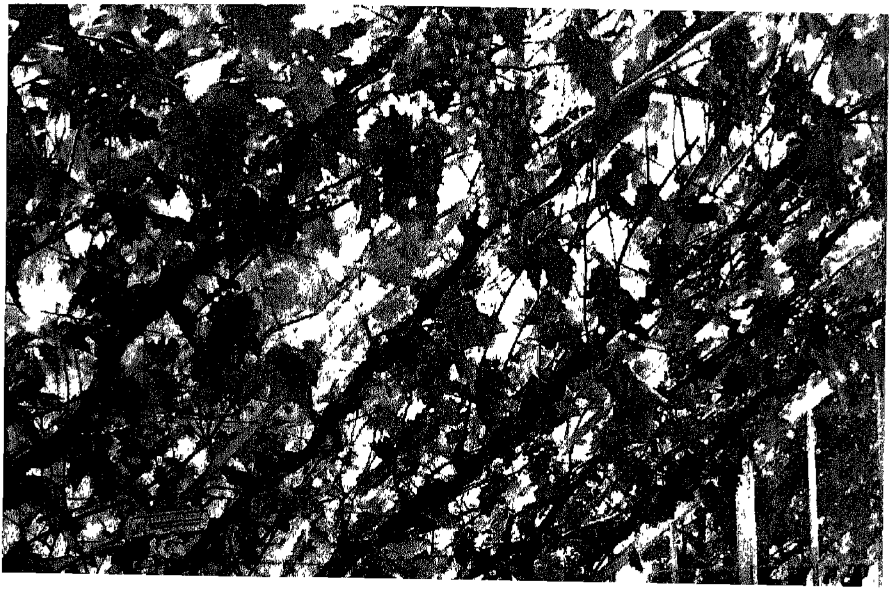
*Those who understand the pleasures of the table appreciate a well-grown melon—and the greenhouse varieties have the best flavour* ⇩

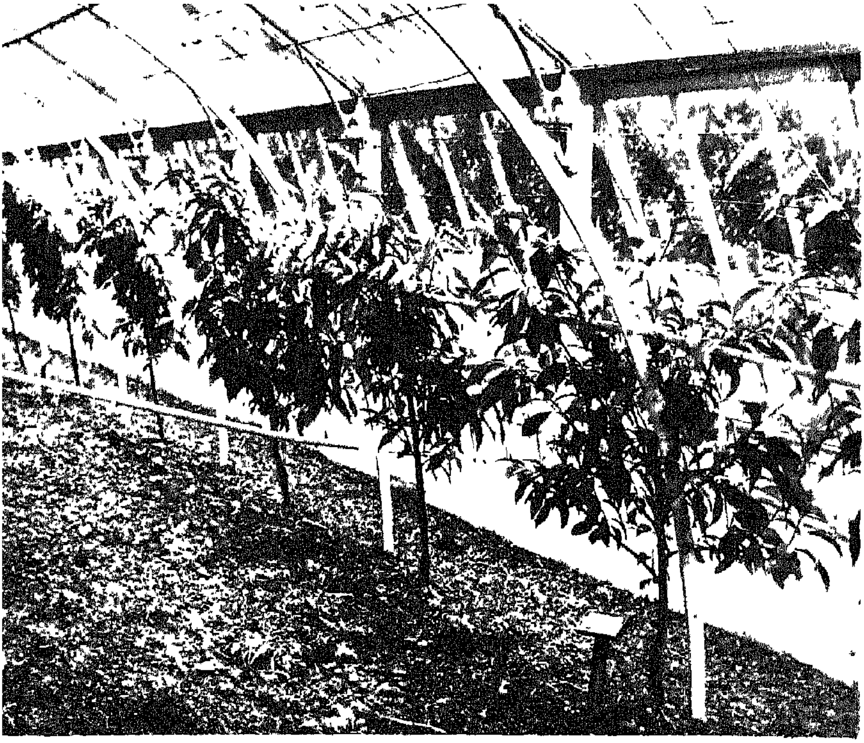
PEACH

*Trained against the wall of a lean-to house or grown under the sloping roof, a well-managed peach tree gives an abundant return for the time spent upon it* ⇨

MUSCAT OF ALEXANDRIA GRAPES

*Well-trained and established with a good crop of shapely bunches* ⇩





*Young peach trees already fan-trained growing strongly in the summer after planting*

PEACH GROWING

*Old-established peach trees trained with skill under the greenhouse roof. They are a sound investment*

is soon enough to introduce the first batch to the greenhouse, first weeding, cleaning and dipping them in a 3 per cent solution of lime-sulphur before top-dressing and setting up on the greenhouse shelf.

When the flowers appear they may be brushed over with a rabbit's tail to distribute pollen; select the first nine fruits to set on each plant and remove all others; support the trusses with small twigs and feed liberally until the colour shows, then use clear water only. At this stage flavour is greatly improved by freer ventilation.

### POTTING FRUIT TREES

Well-developed maiden trees of stone fruits are carefully lifted and potted with the minimum of delay, while they still have plenty of active leaves, towards the end of September.

Apples and pears are best left in the ground another three weeks or more before lifting and potting into 12-inch pots.

The compost for potting these fruit trees is richer than that used for border composition and consists of 2 parts medium to heavy fibrous loam, 1 part well-decayed farm or stable manure, 1 part burnt earth from the garden bonfire, a little mortar rubble, crushed brick and sand, a dash of sulphate of potash and a liberal dressing of coarse bone meal, all well mixed a fortnight or so before potting. If available, oyster-shells, concave side down, are excellent for covering the holes in the pot bottom; these shells are best covered with a layer of quarter-inch crushed bones. Firm potting is absolutely essential and the finished pot should have a space of three-quarters of an inch from top of soil to top of pot to permit watering. After potting, the trees are placed in a greenhouse, kept close and shaded during the day to keep the leaves turgid. Root action will begin very quickly and after ten days the trees may be hardened to outdoor conditions, then they may be stood outside, first choosing a shady spot and afterwards giving them the sunniest position possible. It will take three or four years to train these trees into fruiting bushes, pyramids, short standards or fans; the latter are ideal for peaches and nectarines.

During the whole of the training period they may remain plunged to the top of the pots in an ash bed, lifting them in September or October in alternate years for repotting. This repotting consists of removing some of the old soil about the roots, replacing it with new and returning the plants to the same size of pots.

After five or six years it usually becomes desirable to pot the trees on into larger pots in order to maintain sufficient vigour for continued cropping—15-inch pots being a suitable size for them at this stage.

Figs, apricots, peaches and nectarines are best housed in November before hard weather sets in, but cherries, plums, pears and apples benefit from wintry weather, provided their pots are well protected with bracken against frost.

### PRUNING

Apple and pear trees are subjected to the usual spur-pruning while dormant; peaches and nectarines have a portion of their old fruiting wood removed after gathering the fruits, while summer pinching of the soft growth to form short spurs is the best means of dealing with apricots, plums and cherries. Figs, too, may be pinched at the fourth leaf until midsummer. The cold orchard house is best staged up towards the end of February, choosing a mild spell in which to bring in the apple, pear, cherry and plum trees from the outside ground.

A stiff mixture of clay, cow-dung and water should be prepared to make deep collars around the inside of the rim of each pot, the object of these collars being to form a deep false pot rim to permit top-dressing and feeding.

Syringe the trees and damp the floor when the weather is open, to promote humid growing conditions until the first flowers open, when a buoyant atmosphere should be maintained by judicious ventilation to free the pollen, which is best distributed artificially by means of a rabbit's tail fastened to the end of a cane and passed over each flower at noon or soon after.

After setting, early closing and syringing may be resumed, which, in combination with generous applications of well-diluted liquid manure, will help to swell the tiny fruits. Over-cropping is a common fault which probably ruins more trees than any other cultural error.

All stone fruits, except cherries, require some thinning shortly after setting, but the final thinning should be deferred until after stoning when the cherries may need their numbers in each cluster reducing by one-third.

Peaches, nectarines, apricots, apples and pears may carry from nine to fifteen fruits when well developed in 12-inch pots, while plums may carry eighteen or twenty. These trees in 15-inch pots may be cropped proportionately more heavily, but a good grower gives each tree individual consideration in cropping.

### BANANAS

*Musa Cavendishii* is a dwarf form of banana which is easily fruited in an 18-inch pot. Suckers are rooted in 9-inch pots and then potted on into their fruiting pots while in active growth. Placed beneath the ridge of a 10-foot-high house where the temperature never falls below 55°F. at night, fruits should be produced when the pots are completely filled with roots; feeding is very necessary for fruit development.

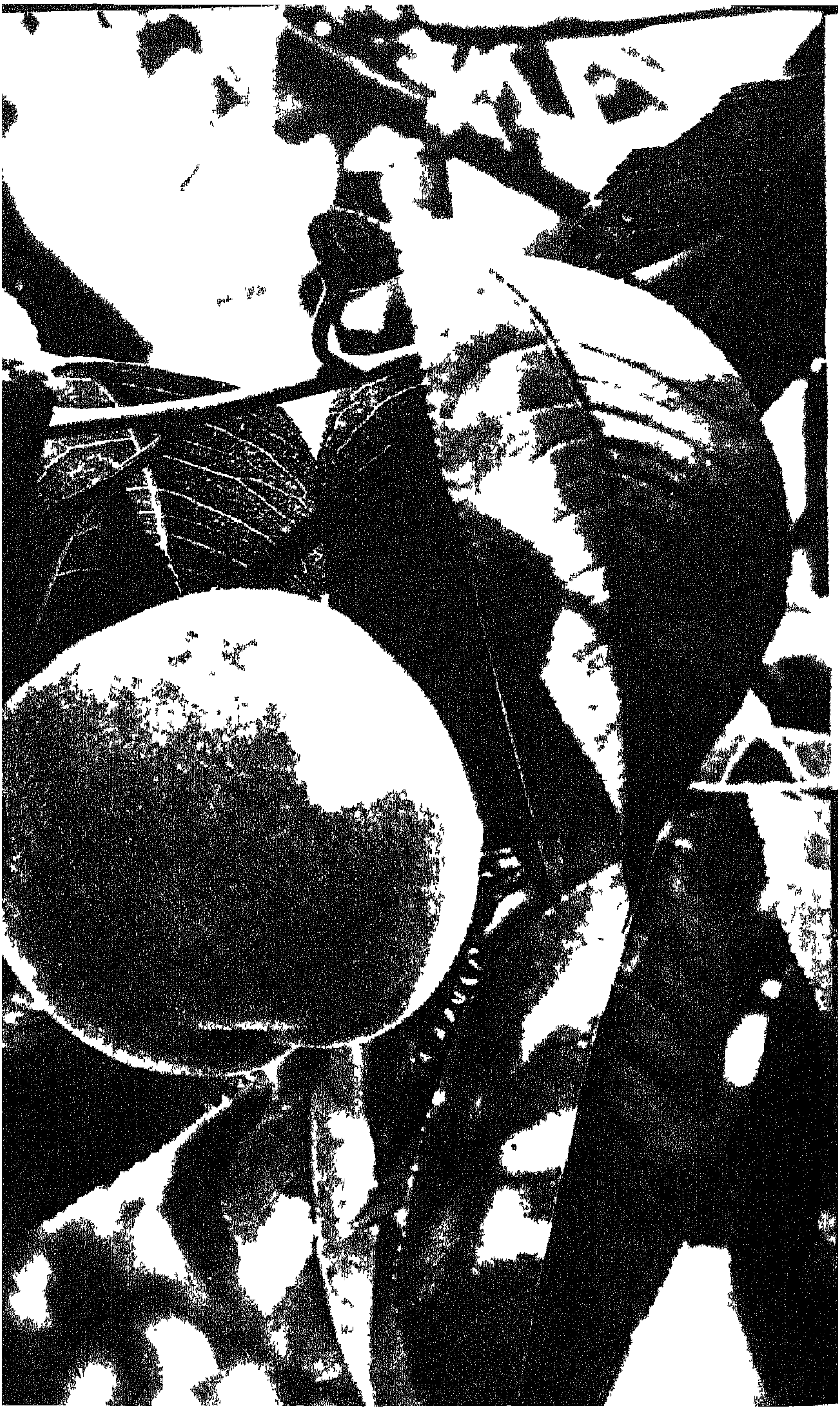
### GRAPES

The grape vine consists in winter of a naked stem with knobbly spurs along the sides. From these spurs emerge, in spring, lateral growths which produce bunches of flowers and eventually fruits. Each lateral growth should be stopped at two leaves beyond the first bunch of flowers produced by it.

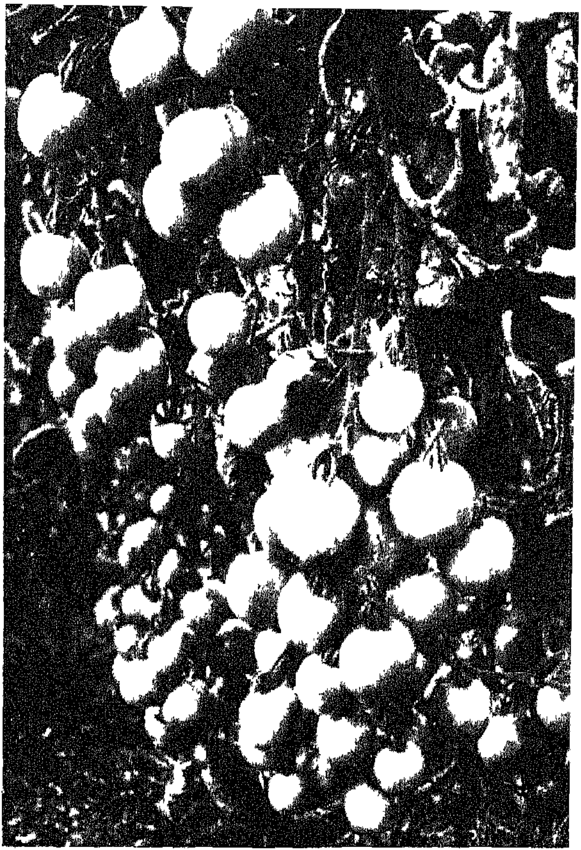
*A young tree of Nectarine Red Cardinal. It is already bearing a profitable crop of fruits*

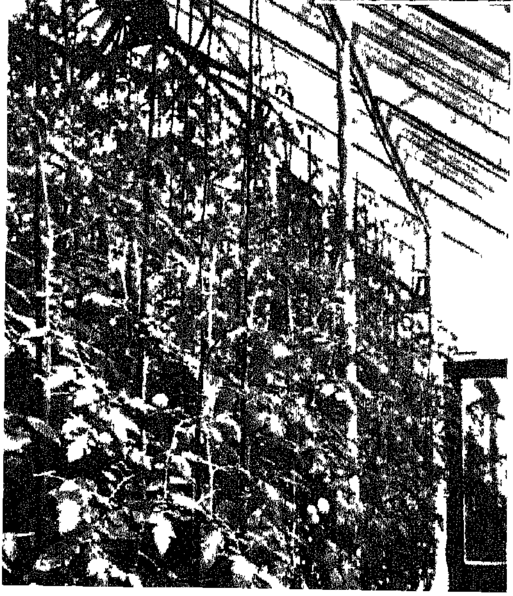
NECTARINES

*Spaced at about 6 inches apart on their stems, the fruits of Nectarine Red Cardinal have plenty of room to develop*



*Given a good short-jointed variety such as Hundredfold or Potentate, a crop of tomatoes can be well worth cultivating under glass* ⇨





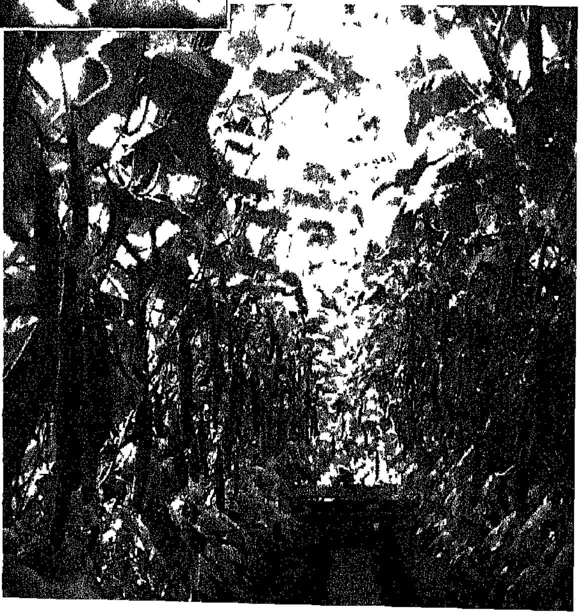
## PROFITABLE TOMATOES

*Many an old vinery or plant house can be made to pay a dividend by growing tomatoes in pots on the staging*

*Butcher's Disease Resister is an excellent variety and is capable of producing long, straight tender cucumbers*

⇦

WELL-GROWN CUCUMBERS



*A valuable crop of cucumbers in a modern metal greenhouse. The borders are made close to the*

# *Vegetables for the Greenhouse*

By NORMAN STEWART

THE GREENHOUSE IN OUR GARDEN SO OFTEN PRESENTS TWO SCENES, DESOLATION in winter and early spring and overfullness with bedding plants, tomatoes and autumn-flowering plants during the rest of the year. The keen gardener will, if he has installed a small heating plant, extend the usefulness of the house with pot plants which are put indoors to survive winter cold and wet or will give welcome colour during dull days.

The housewife, whether she be the gardener or not, and she is either the former or at least the driving force, will certainly eye empty staging and space with some alarm since she can generally see little value in such waste, when from the greengrocer she buys the comparatively expensive lettuce, bundle of rhubarb or head of seakale.

For many years the professional gardener has been producing out-of-season vegetables on the one hand and finishing others whose season of development for the kitchen cannot adequately be completed in the open. It is right that the housewife of mid-twentieth century should demand from the garden an ever-increasing variety of winter and spring crops. In many of our cities and towns these are available, at a price, in either the fresh or preserved form. With a little thought, care and a very little expense these same vegetables, fresh and at hand when needed, can be grown in the greenhouse, nor need they interfere with the use of the house for other plants.

## THE GREENHOUSE

When considering the various crops that can be tackled it is well to take stock of the structure we have or are likely to have, because there are certain features which will limit or extend the range of crops we can grow and the quality that can be obtained.

There is very little value in attempting a green crop such as lettuce in a house which has dirty glass, is shaded by trees or buildings, but the same house could successfully force rhubarb.

While there is much to be said for providing shelter in the way of a wind break, this should be so placed that it does not interfere with light getting into the greenhouse in winter. A high screen of fine mesh wire-netting probably satisfies most requirements by not obstructing light and yet cutting down the force of wind.

The solid wood fence or hedge is most popular whether ornamental or not, but the height must be limited. There is undoubted saving of heat if the full force of wind can be reduced and, if during the spring and summer months shading from strong sun is needed, that can be supplied by the temporary covering of plants and crops by paper, light screen and spraying or an easily removed cover on the glass inside or out.

The greenhouse or lean-to against the side of the house can be tricky, especially with young plants which can easily grow in a one-sided fashion. Where these maturing plants are grown in pots or boxes they can be turned frequently to avoid one-sidedness.

Apart from the above considerations the greenhouse should be in as sunny a position as possible. There is much to be said for having the greatest length running approximately north to south. This will enable the maximum light to cover each surface during daytime. Sometimes the gardener has little choice in the matter.

Choose a level site on the best piece of ground so that for a year or two, at least, crops grown in the borders should be good—at any rate until the soil becomes tired of them. It often happens that there is little choice of soil—it is uniformly poor and in this case two possibilities come to mind. To grow the plants in borders filled with a specially prepared soil mixture or a material not containing soil, e.g. gravel, coarse sand or vermiculite—or depend entirely on the use of pots or boxes of various sizes filled with good soil and either put on the floor or on staging above floor-level. If the existing soil is light or gravelly and will not hold moisture readily, dig in a good dressing of compost each year, or if this is not available, add peat, bark fibre or wool waste.

In addition to supplying varying amounts of plant foods, they act as a sponge for water and plant foods added specially. During spring and summer such soils should be covered with a 1- to 2-inch mulch of organic matter to cut down evaporation of water. Heavy, stiff soils are often difficult to handle in a greenhouse—they waterlog easily and cake on the surface when allowed to dry. The recent introduction of soil conditioners, e.g. Krilium, forked into the top 3 to 4 inches of soil at the rate of 1 pound to every 16 square feet, will produce the most desirable effect of improving drainage and root growth. Such soils are, however, often very productive but need careful watering. Again, the use of a mulch on the surface will help to reduce evaporation. Where the soil is really impossible and contains obviously harmful chemicals, e.g. builders' rubble, the wisest course is to remove the "soil" to a depth of 18 to 24 inches and replace with good soil or concentrate on soilless culture, using washed gravel or coarse sand. In either case it is wise to screen off any neighbouring ground with concrete slabs to the depth already noted to cut down possible contamination.

To go a stage further, the "soil" can be excavated to 12 inches and the bottom and sides covered with a 2-inch-thick layer of concrete. Into this trough can be placed the gravel made up to the original level. This procedure may seem to entail a lot of expense and labour, but if only a part of the house floor is treated great advantages will appear later, e.g. soil rehabilitation is simply a matter of watering the gravel with chemical when the crop is finished and giving the growing crops the right amount of water and plant foods.

An old but still popular and worth-while method, however, is to grow the cropping plants in pots and boxes. The same soilless methods already noted can be used, but most gardeners will feel safer if they set the seeds and plants in a good soil mixture blended to suit all except the most fastidious of plants. The popular John Innes mixtures from a good source will, if backed by sensible management, produce excellent results and take some of the uncertainty out of the job.

The type of greenhouse to use depends largely on what is already available or the purse and hopes of the would-be enthusiast.

On the market today is a whole range of erections from the outdoor cloche to the more elaborate structures of wood, metal or concrete furnished with every conceivable device for keeping plants just right. Obviously, size of house has a good deal to do with its usefulness, but more important than that is the value of the light which gets through.

Most houses have narrow panes and are often draughty. A number of the newer models are a distinct improvement, and there is no reason at all why the gardener-handyman should not watch points if he intends building his own. The following features are notable: lighter structure (except with the concrete models); bigger single panes of glass and a higher proportion of glass to the total area; rot-proof materials which do not need frequent painting; simple erection, fitting and replacement of parts; better and more controllable ventilation; fewer obstructing parts indoors; simpler, cheaper and more efficient heating possibilities; and improved "floor" layout. Special attention must be paid to heating if the fullest use is to be made of the house, and the newer forms embracing solid and liquid fuel and electricity should be noted.

There is a good deal of evidence to support the value of soil-warming, linked, if necessary, with space heating to hasten the maturity of crops which are so much more useful than those which drag out over a longer period and may have to be used before they are ready. Recent work on artificial light in greenhouses, especially for winter and spring use, may at the moment seem beyond the scope of most gardeners, but it is worth keeping an eye on developments, as cheaper and simple techniques appear. But let it not be thought that elaborate equipment will automatically produce the crops.

Disappointment and possibly failure will result if due regard is not paid to

Where some form of heating is available it will be possible to plant in early January from seeds sown in early December, but with an unheated house, plants should not be put out until late February or early March.

The soil for tomatoes should be well prepared in advance. The foundation for good growth and crops is a fertile soil. Use only well-rotted manure or compost and dig the soil deeply, allowing it to settle before use, and if it is dry give a thorough watering. A dressing of good general fertilizer raked into the soil before planting should give the plants a good send-off.

Sow the seeds of the selected varieties, e.g. *Potentate* for the heated house and *Moneymaker* or *Ailsa Craig* for unheated houses.

A small packet of seeds will probably give enough plants for the small house. Various techniques can be used: either sow the seeds in a pot or pan in a temperature of 45° to 50°F. and prick off the seedlings into pots and boxes when large enough to handle, or space the seeds about 2 inches apart in a shallow box to grow on until large enough to plant out. A very thin covering of soil only should be put over the seeds. Avoid checks in growth and too much watering—the root of most troubles with tomatoes.

Between seed sowing and planting give the house a thorough clean, both glass and framework.

There are very many designs for spacing tomato plants—equal spacing between each; wider spacing between rows than between plants; but overcrowding can lead to trouble. Most gardeners find that 18 to 20 inches square allows them to get very good results or 24 inches between the rows and 15 inches between the plants.

A warm soil, as much as air temperature, is vital to steady growth, and it is here that electric cables laid underneath will help—as they will all crops growing or being planted in winter or early spring. The soil temperatures should not be less than 45°F., with an air temperature slightly above this at night and 50° to 55°F. during the day.

Set the plants out at the selected distances, making sure that they are well watered beforehand. In this case they need not be watered until there is obvious sign of renewed growth. In bright weather syringing early in the day will help to stop flagging of leaves. Plant out only the stockiest plants, and if your own plants are not good enough do not hesitate to scrap them and get a better sample from the nurseryman. Ventilate on fine days and do not allow a stagnant atmosphere to develop.

As soon as the plants are growing steadily support will be needed. The simplest method is to bend an 18- to 24-inch long piece of No. 10 gauge wire in the form of an inverted U and push it into the soil beside each plant. Tie stout string to this and fix the other end to the cross wires in the roof of the house. If the plants are being grown in pots or boxes the same device can be used or a clean bamboo cane long enough to last the plant while fruiting—and if necessary fixed to the cross wires. Those plants which are growing at the side of the house can be trained up the cross wires. As the plants grow they can be tied to the support or twisted round the string until the tops are removed to stop them growing any longer.

The first flowers are the most important, as the fruits from them are the most desirable, being early. As soon as they begin to open, help pollination by dusting the flowers with a rabbit's tail on the end of a cane, moving from one plant to another.

This treatment is invaluable during the dull days of late winter and early spring. The later trusses should not need this treatment provided good ventilation is carried out and, of course, during the summer months full air should be left on by day and night.

*Feeding and Watering.* During the season water the soil regularly, keeping it moist, and in summer more frequently than earlier.

To help maintain growth and cropping, at least one top-dressing of a good plant food should be given, the first as soon as the second truss of fruitlets has begun to swell—earlier if necessary, and a second when the fourth truss is swelling, and so on for the remainder of cropping. Some excellent brands of special fertilizer are available for this purpose. These treatments will help to keep up size and quality of fruits and shoots until cropping finishes in late summer.

To help cut down loss of water from the soil, light shading may be put on the glass or a mulch of peat, bark fibre or compost about 1 to 2 inches thick over the soil; allowance should be made for this and any other top-dressing, including extra soil when pots and boxes are used. The plants will root into this and benefit considerably.

Side-shoots will appear along the main stem and all should be removed completely when only a few inches long, unless needed to replace a damaged main shoot or a neighbouring plant which has died.

In this connection remove and burn any diseased plants during the season. As each truss of fruit is picked, remove the lower leaves up to the next truss to facilitate air movement. When cropping has finished, say, late August, clear the house of all plant material, string and so on, and prepare the soil for the next crop.

One last point—it is possible to plant the tomatoes as an interplant with early indoor lettuces.

*Peas.* By careful choice of early maturing and dwarf varieties of peas, such as *Meteor*, good crops are obtainable.

If a space in the soil is available—say, after tomatoes—so much the better, but pots and boxes on the bench will answer very well. Provided the soil is fertile this crop needs no special treatment, though the addition of lime raked into the surface before sowing is an advantage. Where the John Innes composts are used for pots there is no need to add lime.

Sow the seeds half an inch deep and space them 4 to 6 inches apart—in rows 12 inches apart—in October. As mice are likely to be troublesome it is advisable to coat the seeds with a paste of red lead and paraffin.

Where soil-warming is carried out germination is rapid and as soon as the plants are 3 to 4 inches through the soil, support from sticks or suitable trainers is worth-while. In this way a crop will be ready to pick in late January or the beginning of February. A second sowing fourteen days later than the first will extend the season.

Give full ventilation on all fine days and water the soil only if it is really dry. In a cold house, cropping will probably not begin until mid-February and a second sowing correspondingly later. The crop can then be cleared and the house is ready for summer use.

*Dwarf Beans* can be a very acceptable crop under glass and the soil preparations are the same as for peas. In fact, young plants previously sown in pots can be planted immediately the peas are cleared and will give early crops of tender beans. Alternatively, the seeds can be sown in pots, boxes or in the house border in January, with sowings at fourteen-day intervals after. Space the seeds 6 inches apart in rows 12 inches apart, and 1 inch deep. Again, germination will be rapid in warmth and beans will be fit to pick in April and May. As the plants tend to become leggy, some support may be needed, but again good ventilation and avoidance of overfeeding will help. Water the soil thoroughly as necessary. Suitable varieties are *The Prince, Masterpiece, Feltham Prolific.*

*Runner Beans* are not a usual crop for the small greenhouse, but a few plants growing up a string will produce as many beans as a greater number of dwarf plants that take up more space. Excellent crops can be got from a few seeds or plants put in at the end of a house where they get plenty of sun early in the season—April and May. When they are cropping they will help to shade the other plants in the house.

Seeds of selected varieties, e.g. *Princeps*, are sown in mid- to late January in soil, as for peas. Space each seed about 9 inches apart and 1 inch deep. In warmth, germination is rapid, and before the plants begin to trail a similar support is given as for tomatoes.

Give ample ventilation whenever possible and keep the plants moist. A buoyant atmosphere is essential when flowering begins. Early sowings will give crops for picking from late March onwards. For all these crops an air temperature of 45°F. at night and up to 65°F. during daytime is ample.

*Cucumbers* can be cropped indoors from April to September by making successional sowings. A good fertile soil is necessary to get the best results, and if grown in pots and boxes John Innes potting compost No. 3 is excellent. With pot work seeds may be sown where the plants are to crop, but it is usual to germinate the seeds as a separate operation. Early sowings are made at the beginning of January in a warm house temperature not less than 65°F. or in late February in a cool house. As soon as they are large enough the young plants are set out each 15 to 18 inches apart. If the material is available for making a hotbed this will help in the cold house, but protection of the plants from early frosts is essential.

One or two shoots are allowed to grow from each plant—one is probably enough at the above spacing, and supported as for tomatoes.

Growth will be rapid, especially if temperatures can be kept up to 65°F. at night, and humidity is high—this latter can be achieved by damping the floor at least once a day, especially in summer.

Regulate ventilation carefully for the early crops, but in summer full air can be given day and night. Keep the soil moist.

The main shoots are allowed to grow unrestricted until they reach the full length allowed, when the growing point is removed.

Lateral shoots will form flowers and fruits readily at the first or second leaf joints and should be pinched at the first or second leaf beyond a developing fruit—especially with sub-laterals. These shoots can be tied to any suitable framework to avoid overcrowding.

Remove any yellowing leaves as the plants develop and any surplus shoots. A top-dressing of John Innes compost No. 3 every three weeks will keep plants growing and cropping happily until late summer.

Muslin screens tacked over the ventilators will prevent insects fertilizing the flowers and spoiling the fruits, although removal of all male flowers also helps.

If heating, 60° to 65°F. is available, very early crops, fruiting from late December onwards, can be obtained by sowing in mid-October. Good varieties are *Butcher's Disease Resister* and *Rochford Market*.

The *Radish* is a very popular, quick-growing salad crop and can be cleared in about six weeks from time of sowing. It is very suitable in heated houses with a temperature of 55°F. and sowing after a summer or autumn crop, e.g. tomatoes or chrysanthemums. Radishes can be grown with lettuces. The seeds may be sown in rows or broadcast in beds or boxes in any good soil. Crops growing in winter will require no watering, but those maturing in spring will need water. December is not a good sowing month.

Good varieties are *French Breakfast Forcing*, for heated or unheated houses; *Red Short Top Forcing*, in heat.

# *Orchids for the Cool Greenhouse*

By L. STENNING

THE CONNOISSEUR WHO IS INTERESTED IN ORCHIDS CAN SUCCESSFULLY CULTIVATE a number of the cooler growing species and varieties in a small house with a temperature in winter of 45°F., and a temperature of 65° to 70°F. in summer. First a few words about the house: it can be constructed of wood, or aluminium, provided it has ample top ventilation. This is essential to keep the house cool during the summer months. The stages should be so designed that they can be covered with 2 inches of fine shingle or coarse well-weathered ashes, on which the plants will stand. The same material should be used to cover the soil under the benches. The reason for this is to create a good humid atmosphere, which is essential for orchids, by damping this material down two or three times a day. Orchids should always be watered with soft water, and adequate tank space should be provided to store the rain-water from the roof of the house; the tanks can be constructed inside the house under the stage, and dipping holes left large enough to get a water-can in and out. The house should be equipped with shading, for orchids resent strong sunshine. The shading can either be blinds, or the glass can be stippled with summer cloud, or a similar paint, applied in early spring. The house can be heated by hot-water pipes arranged under the stages, or by an electric heater specially designed for greenhouses and thermostatically controlled.

The following are the most suitable orchids recommended for growing together in a cool house.

*Cymbidiums.*/These very popular, decorative plants have come very much to the fore during the past few years, and many fine new hybrids have been raised. These are evergreen plants, with close-set tufts of long, narrow, leathery leaves, and short rounded pseudo-bulbs, from which the leaves and flower spikes are produced. The flowers are borne on long racemes often 2 to 3 feet long, and frequently pendulous. They are very attractive, and have long-lasting qualities both on the plant and when used as cut flowers. The plants produce thick fleshy roots, and require plenty of root room in their pots; they will flourish in a good, rough, open compost comprising two parts good fibrous loam, one part rough peat or osmunda fibre,/ one part decayed leaf-soil, broken charcoal and sharp sand, well mixed together. When the plants require repotting, this operation should be carried out in late spring and summer, when they have finished flowering and just commenced to make new growth. Newly potted plants should be watered very carefully for a time until they have made new root action, when the water supply can be increased. When in full growth they can be watered freely. In autumn, when the new growth has fully developed, the plants should be given more sunlight to ripen up the new growth, which should flower in the following season. In the winter, when the plants are resting, do not dry them completely off; give them sufficient water to keep the pseudo-bulbs and leaves plump.

*Paphiopedilums.* These plants are better known as Cypripediums. They are interesting orchids, and belong to the terrestrial group. They produce erect, leafy, deciduous stems, bearing leathery leaves from which one or more flower spikes emerge. The flower is rather curious; the parts are the dorsal sepal, erect and usually highly coloured, two spreading elongated petals coloured and mottled, and a slipper-shaped pouch also highly coloured, from which this plant gets its common name "The Lady's Slipper".

These plants are fairly easy to cultivate, and the majority of the *P. insigne* hybrids will flourish in a cool house. It should be borne in mind that these Paphiopedilums are unlike many other orchids. They have no thick fleshy pseudo-bulbs in which to store food to keep them in good health during the resting period, so they should never be allowed to become dry at the roots when resting in the winter. They thrive best in well-drained receptacles in a compost of two parts fibrous peat, one part decayed leaf-soil, one part sphagnum moss, broken charcoal and sand well mixed together. Repotting should be done in late spring when plants have finished flowering and are commencing to make new root action. Remove as much of the old compost as possible and cut away any old and decayed roots, leaving the young roots to be worked into the new material in a well-drained pot. After repotting keep these plants at one end of the house, where they can be sprayed with rain-water between the pots, and overhead when weather conditions permit. Water moderately for a time until established, when a more liberal quantity will be necessary; such watering to be continued through to the growing season. They can readily be propagated by the division of large plants at the time of repotting.

*Lycaste.* These are very useful ornamental cool-house orchids that should find a place in the amateur's collection. They are easy to grow and will thrive in the same compost as recommended for the Paphiopedilums. They should be watered and treated in the same way as the Cymbidiums. The following species are worthy of cultivation: *L. aromatica*, with delicately scented golden-yellow flowers, produced in numbers, around the pseudo-bulbs; *L. Deppei*, with white petals, green sepals and yellow and crimson lip; *L. Skinneri*, with deep rosy-pink flowers; *L. Skinneri alba*, with white flowers. The latter are handsome plants when in full flower.

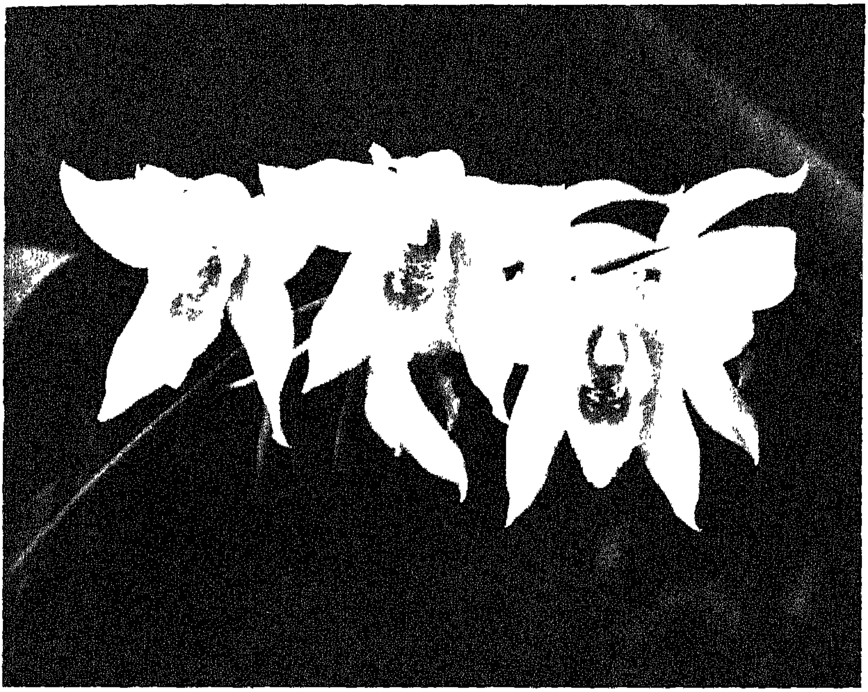
A few other orchid species that are worthy of cultivation in a cool greenhouse, and will respond to similar treatment to those already mentioned, are:

| | |
|---|---|
| *Ada aurantiaca.* | Bright orange-coloured flowers. |
| *Coelogyne cristata.* | White flowers with a blotch of yellow on the crests of the lip. |
| *Epidendrum radicans.* | A scandent orchid with orange and scarlet flowers. |
| *Oncidium varicosum.* | Bright yellow flowers. |
| *Oncidium varicosum* var. *Rogersii.* | Golden-yellow flowers, with a few bars of reddish-brown. |
| *Vanda coerulea.* | Blue or pale blue flowers, in August and September. |

*Insect Pests.* Aphis or green fly often appears on the plants, especially when they are commencing to flower. These can easily be controlled by spraying with a nicotine or derris insecticide, according to instructions given on the container. Thrips can be very troublesome insects in spring and summer and they can do considerable damage in a short while. Their presence is soon detected by small round marks on the foliage and flower buds. They can be controlled by spraying the plants with D.D.T. insecticide at frequent intervals, again taking care to mix according to instructions.

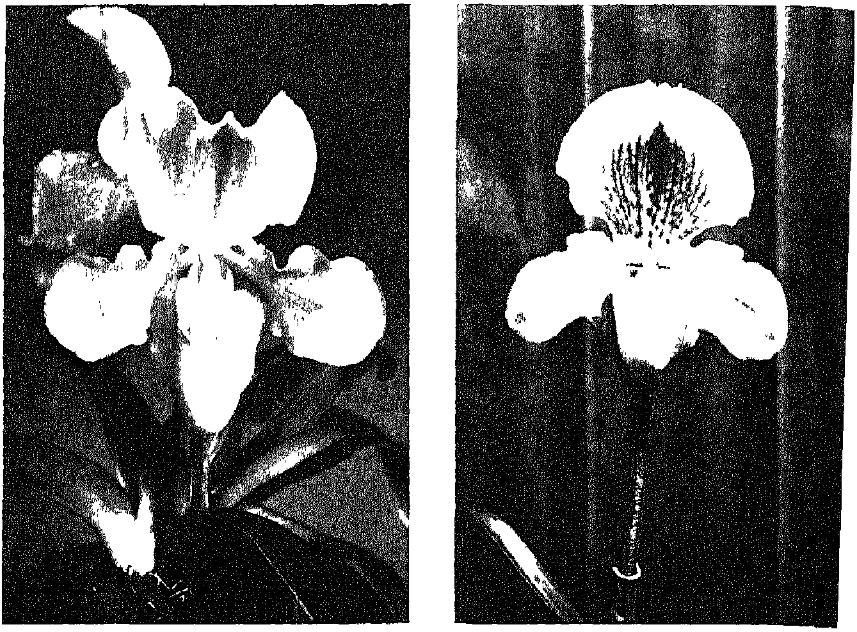
The cool greenhouse orchids, like many other cool growing plants, love plenty of fresh air during the growing season. The top ventilators on the house can be left open day and night, during the summer months, when weather conditions permit. To maintain a good humid atmosphere during the growing season, make sure the stages and floors are well damped down two or three times a day, and in the late evening during very hot weather. Orchids when well established and making luxuriant growth, will greatly benefit from frequent applications of liquid manure. This should never be applied to plants when they are dry at the roots.

In conclusion, I should like to point out that I have only mentioned a few of the cool growing orchids. There are many other fascinating ones that may be grown. These can be obtained from the leading orchid nurseries, and will flourish under the conditions recommended.



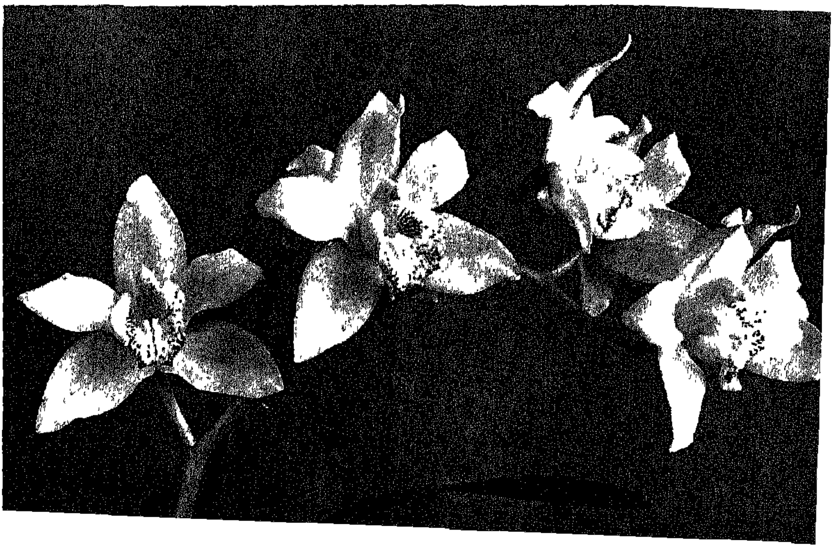
*This dwarf evergreen orchid,* Coelogyne Mooreana, *blooms in late spring and summer. The flowers will remain in perfect condition for some time if kept cool and free from damp*

*A beautiful dwarf orchid for the cool house.* Pleione Pricei, *a native of Formosa, produces its delicate rose pink flowers in early spring, after a season of rest. This plant is very easy to cultivate*

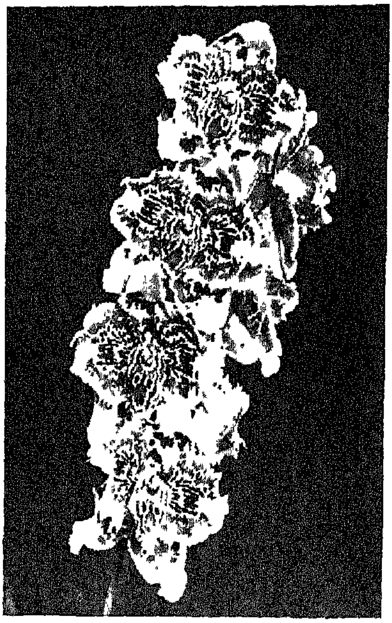


*These are very popular orchids and can be readily cultivated by the amateur. The flowers of the Paphiopedilums (Cypripediums) differ in general appearance from those of other orchids. The common name "Lady's Slipper" was derived from the inflated pouch*

*These orchids are most attractive, and are very popular plants for decorative work. The handsome and delicately coloured flowers of the Cymbidium species and hybrids are produced in profusion in early spring on established plants*



The flowers of Cymbidiums will remain in excellent condition for many weeks if kept cool and shaded from strong sunshine

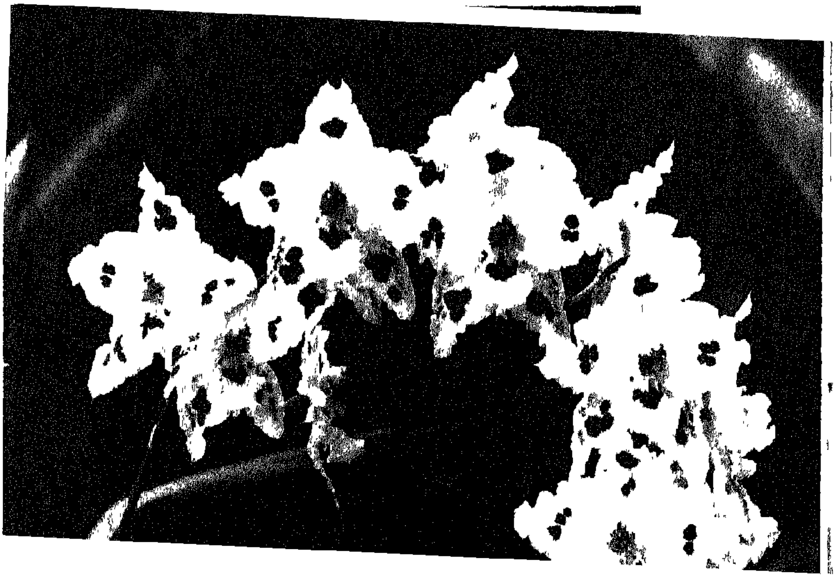


Among the most floriferous types of cool orchid, and fairly easy to cultivate, Odontoglossums require abundance of water during the growing season

A very attractive genus comprising a large number of species, and varieties Miltonias are evergreen, compact in habit, and the foliage has a yellowish appearance. They should be watered freely during the growing season. The flowers are very elegant and colourful

*This is a tropical orchid and requires to be grown in a very warm, humid temperature of seventy to seventy-five degrees. Phalaenopsis species are very elegant when in flower, but not suitable for the cool orchid house*

*The attractive* Odontoglossum Pescatorei *showing an excellent spike of white flowers blotched with red-brown markings. These flowers will remain in good condition for several weeks if well shaded when in flower*



# *Gardening Aids*

### By ROBERT PEARSON

GARDENERS ARE ALWAYS SOMEWHAT TARDY OF ACCEPTING THE EVIDENCE OF statistics; they can, too often, be made to prove their author's point. But even so, it would be interesting to have an accurate indication of the increase in garden costs during the past decade. Even without the benefit of such detailed knowledge, most garden owners are only too well aware that many long-established gardening practices, perfectly satisfactory in times when labour was both cheap and plentiful, are now hopelessly uneconomic and impracticable. Plants and garden sundries are also costing more, but most will agree that prices are reasonable for present-day conditions; the plant supplier and the manufacturer also have to contend with rising costs in an industry that is highly competitive. Taking all these points into consideration, the only answer is for the garden owner to reduce his working costs and garden more efficiently by making as much use as possible of the many gardening aids—a high proportion of them labour-saving—which are now available. To put a difficult problem in its simplest form, the owner of a garden of half an acre or over is now faced with two alternatives: to continue to run his garden without modern, labour-saving equipment, and so incur heavy expenses, or to use such devices as much as possible and make do with the minimum of outside help. Obviously, to reorganize a garden on these lines will involve the owner in considerable capital expenditure, but, as a long-term investment, with the subsequent saving in labour and time, it would certainly prove financially advantageous. For smaller gardens, too, there are many gardening aids which are worth adopting. Equipment, such as cloches, which will enable valuable food crops to be raised out of season when prices in the shops are high, should also be employed as much as possible; the use of modern irrigation methods can do much to ensure the production of maximum crops. With commendable ingenuity, the makers of powered garden tools have adapted the low-powered electric motor and internal combustion engine to their needs, and light-weight metals are being increasingly employed in the construction of garden tools, with the result that many jobs are now far less tiring to perform. Plastics, too, with their dual advantages of lightness and durability, are coming into their own in the garden.

The great quantity of gardening aids now available is, perhaps, best appreciated by a visit to the sundries avenues of that Mecca of all gardeners, the

Chelsea Flower Show, but most good garden sundries stores carry a wide range of these modern aids to gardening. With such a wide choice, then, it is especially important that the garden owner should have an accurate appreciation of his needs; errors of judgment can prove expensive. Before buying any piece of equipment one should certainly consider carefully whether it is suited for one's particular conditions, taking the price and its estimated period of usefulness into consideration; also whether it is going to save time and money, or only the expenditure of energy—something which is well worth paying for in certain circumstances.

### LAWNS

There is surely nothing the average gardener tends with more care than his lawn; well-kept lawns are part of the British tradition, and certainly few features look lovelier, especially on a sunny summer's day. But it must be admitted that they can take up a lot of time which could be usefully employed doing other jobs in the garden. For those who have medium-sized or large lawns the powered mower is the obvious answer, and a very wide range of these, driven by petrol or electrical motors, is now available. Both have their advantages, and whichever is chosen is a matter of personal preference—those who have grass areas well away from the house to deal with will probably prefer to use a petrol-driven mower, as this is, of course, a completely independent unit; the electric machines have the great advantage of being almost noiseless and requiring little in the way of maintenance. The electric mowers operate from the mains supply, and in large gardens power points can be so sited that all parts of the garden can be reached without using an unduly long cable.

Petrol-driven machines are now on sale at an extremely competitive price, and will doubtless be purchased by many gardeners who have hitherto considered a powered machine a luxury they could not afford. An even cheaper way to take the hard work out of mowing is to buy one of the petrol-motor or electric-motor units for converting an ordinary roller-type hand-mower to power. With the electric-motor unit the drive is only connected to the blades, which it rotates at a constant speed, irrespective of the speed at which the machine is pushed; the petrol-motor unit does both jobs—rotates the blades and propels the machine forward. Both these power units do an efficient job, and their introduction has been a boon to the man of moderate means whose expenditure on garden equipment must, of necessity, be limited.

We all know how annoying it can be when prostrate grasses and weeds miss the blades of the mower. There is now a rake attachment, for fitting to the front of the box on the mower, which overcomes this trouble, and rakes the lawn into the bargain. This excellent tool can be used on both hand- and power-operated machines. Edging the lawn and grass pathways can be a tedious and time-wasting task in a large garden; such gardens often have as much as a mile of edges which must be kept tidy. For doing just this job there is an ingenious electrically-operated edger, driven either from the mains supply, a standard 12-volt car battery or a portable generator. With this tool, edging is effortless, and one can trim the lawn and the edges of grass paths at walking pace. Another electrically-operated machine from the same firm is designed to cut long grass in awkward places, such as on steep banks and among stones, inaccessible to an ordinary mower. This machine works on the same principle as the edging tool—a revolving cutter bar beneath a forked plate—and some of the parts of these two machines are interchangeable. There is a wheeled version of the grass cutter which is much quieter—a desirable feature in built-up areas—and as easy to use as an ordinary household vacuum cleaner. It can also be fitted with aluminium rollers instead of wheels to give a really close cut.

A tool which is useful in any garden is the scarifying wire rake. With twenty strong but thin tines radiating outwards in fan formation, it is excellent for removing litter from turf and ash paths. Another tool which has won for itself an enviable reputation is a long-handled edging shear, made of light-weight rust-resistant steel. For the garden which is too small to make an electric edger worth-while, this tool is admirable.

Hand-weeding is a tedious job which few of us enjoy. So far as the lawn is concerned hand-weeding is a thing of the past, for the modern "hormone" type, selective weed-killers, which take little time to apply, do a wonderfully efficient job. These weed-killers are available in the form of dusts or sprays. There are also combined weed-killers and fertilizers which kill the weeds and give the grass a tonic at the same time. Moss, too, can be a great nuisance in turf which is not well-drained or aerated, and the old method of trying to rake it out never gave really satisfactory results. This was because the spores and growths left below ground-level formed new plants. Now, however, there is a really effective method of control: the mercuric moss-killers. These are available as a combined fertilizer and moss-killer; as a moss-killer only; as an eradicant for application as soon as moss is noticed; and as an eradicant in concentrated form.

## HEDGES

The power-operated hedge-trimmer has become very popular in recent years, and in most large gardens it has become an almost essential piece of equipment. Nor is this surprising, for with such a tool it is possible to trim a hedge in a fraction of the time taken to do the same job by hand. For any garden with extensive hedges the electric hedge-trimmer will be found a great time-saver, and tall hedges can be dealt with by fixing an extension handle to the machine. For those whose gardens are not large enough to justify the purchase of an electric hedge-trimmer—or who prefer to cut their hedges by hand—there is a first-rate hand shear made of rust-resisting, light-weight steel. This is a beautifully balanced tool, and a great advance on the heavy models which many gardeners still use.

## STAKING AND TYING

Staking and tying are jobs that can take up a lot of time, and many herbaceous plants need considerable attention in this respect during the growing season. One way to avoid—or at least to mitigate—this problem is to grow as many self-supporting plants as possible. But, even so, there are plants with less accommodating habits which should be included in any border that is to be really interesting. The best way to deal with these is to stake them early, before they have made much growth, with well-branched pea-sticks; the growths will extend through these and before long the sticks will hardly be visible. For carnations, sweet peas and similar plants, wire split rings give excellent security; and they can be placed round the supporting stick or cane in a trice.

Tying tape, which is excellent for securing plants with a limited life, can be bought on a reel, and this is fitted with a wire hook so that it can be hung from a button-hole. The advantage is that it leaves both hands free. Also very helpful in this respect is a neat little string cutter, which consists of a plastic ring—for slipping over the finger—with a protected cutting edge.

If correct planting is the biggest factor in successfully establishing trees and shrubs, then correct staking and tying during the following four or five years is a close runner-up. Many fine young trees have been ruined or mutilated in rough weather by inattention to this seemingly small detail. One can still, of course, use the old-fashioned string and sacking method of tying, but the new plastic and rubberized tree ties, which are now available at reasonable prices, are much easier to put on and certainly easier to adjust—and adjusted they must be at regular intervals to avoid restriction of growth. These ties stand up well to the weather and they have very considerable tensile strength.

For the gardener who has to erect posts in any quantity, the wonderfully efficient post driver is a worthwhile investment. With this tool it is possible to insert even large posts without preparing holes in advance, and the posts only have to be pointed where the subsoil is very hard. The tool consists of a hollow iron tube some 3 feet long, which is blocked at the top end. This is placed over the top of the post and lifted and dropped by the handles fitted on either side. All the force is concentrated where it is most needed—at the top of the post. A great advantage, too, is that the top of the post does not get damaged, as frequently happens when a sledge-hammer is used. Extension handles can be fitted for driving in posts of up to 14 feet in height. This post-driving tool is obtainable in various sizes—the smallest for garden purposes needing only one operator, some of the larger ones requiring two. Another tool, working on the same principle, will drive in tall stakes and bamboo canes.

### WATERING

Few gardens in Britain hold sufficient moisture in the soil during the growing season to produce maximum crops, strange as this may seem to those who have not given the subject much thought. Artificial irrigation is, then, of vital importance if the best use is to be made of the garden space available; great advances have been made in this field during the past few years. We have seen the introduction of the leaky hose and trickle irrigation in various forms. This has the very considerable merit of putting the water just where it is needed, and as the water seeps directly into the soil very little is lost through evaporation. One firm markets a porous, canvas hose, in 18-foot lengths, for attaching to ordinary hose-piping or a stand-pipe. The other end is blocked with a metal cap and the water seeps steadily into the soil throughout its length. Another firm has introduced a leaky hose made of rubber tubing—for attaching to ordinary hose-piping—and this is fitted throughout its length with plastic nipples through which the water seeps. The water can be conveyed through half-inch piping at a pressure of as little as 2 pounds to the square inch, and a refinement is that liquid fertilizer can be applied through this system direct to the roots of the plants. The liquid feed attachment works on the visual drip principle and the amount of fertilizer which actually reaches the roots of each plant can be determined within close limits. A special harness allows three rows of cloches to be irrigated in this way at the same time.

One of the neatest—and certainly the cheapest—garden sprinklers which I have come across has no moving parts, and, hence, practically nothing to go wrong. The construction of this handy little sprinkler is such that the water is distributed in a fine spray over a circular area of approximately 250 square feet. It fits in the end of an ordinary garden hose and has a spike attachment for anchoring it to the ground, or for holding it by, if it is required for washing down walls, paths or similar work. Most attractive of all is its price: it costs only five shillings.

Another, more elaborate, irrigator gives a square coverage of 50 feet by 50 feet, swinging through an arc of 110° by means of an oscillating device. It can be fixed in any position, if so desired. The seventeen nozzles supply 250 to 300 gallons of water an hour to the soil in the form of a fine spray resembling rain.

Plastic hose-pipes are proving very efficient, and they are standing up well to our varied weather conditions. Perhaps their greatest asset, though, is that they do not kink—always a trouble with rubber hose-piping. One very neat plastic hose has flattened sides; consequently it takes up much less room than other hoses when not in use. This particular hose is supplied with a light-weight frame, fitted with a handle, on which it can be wound in a matter of a few moments.

A device which allows liquid fertilizers to be fed through any overhead irrigation system is also an immense help to gardeners. It consists of a round canister with various attachments, and is screwed on to the hose which brings the water from the tap. The fertilizers, which are bought in powdered form, in any one of four formulae to meet the needs of different crops, are released in liquid form into the spray system.

Cloche irrigators, made of galvanized iron corrugated strips, are another simple but effective aid to gardening. The bottom of the cloches rests on the irrigation strips and rain-water is directed where it is most needed—under the cloches and around the roots of the plants growing under them.

### WEED-KILLERS

Selective weed-killers for use on lawns I mentioned earlier; there is also a non-poisonous, selective weed-killer which will destroy weeds in hedges, around trees and shrubs, roses and fruit bushes. The same firm also markets a weed-killer for use on paths and hard tennis courts. Another proprietary product, containing the new chemical 2,4,5-T, clears weeds from rough ground, and destroys brushwood and brambles. Provided cultivated plants are not touched by this spray, and it is applied carefully with a knapsack-type sprayer, it may be used to remove weeds in beds or around trees and shrubs. It is also used for removing weeds from paths, roadways, ditches and so on, and it will kill the stumps of even large trees if applied at the correct time. When using any of these weed-killers, selective and otherwise, it is absolutely essential to follow the maker's instructions strictly to obtain good results, and also to avoid damaging other plants.

### MECHANICAL CULTIVATORS

Whether a particular garden is large enough to justify buying a mechanical cultivator is, of course, something which only the owner can decide. Such cultivators save an immense amount of hard, slogging, hand labour, and will do in hours what would take weeks to do by hand. If casual labour is employed to do hand-digging, this is certainly an important thing to consider. For breaking down really rough ground and for inter-crop cultivations they are invaluable, and my opinion is that for the owner-gardener with half an acre or more of ground devoted to food crops they are a very good investment.

A fine little cultivator which I have particularly in mind is powered by a petrol engine of 1·25 b.h.p.; and it is reasonably priced. The engine drives the road wheels and a four-bladed rotor, which really does dig the soil.

There are, of course, many other good machines on the market, and it is up to the purchaser to get the right one for his type of garden. The larger cultivators are fitted with numerous attachments, such as tool bars, grass cutters, sprayers and so on, but these are growers' rather than gardeners' implements, and it is only in really large gardens that they can be used to full advantage.

Another useful tool is a mechanical hoe, powered by a small petrol engine.

## FRUIT CROPS

No fruits taste quite so good as those grown in one's own garden, and most gardeners will go to considerable trouble to ensure that pests and diseases are kept under control. Birds, for instance, can do an enormous amount of damage to soft fruits in a very short time, and a really efficient fruit cage is something which more than earns its keep during the weeks when the fruits are ripening. The latest type of fruit cage must have come as a rude shock to our feathered friends (I mean friends, for we would not be without them). They are easy to erect, consisting of galvanized posts and rods—which take only a few moments to put together—covered by fish netting or steam-tarred, square mesh netting. They can be built up to various heights and are equally useful for protecting seed drills, soft fruits and bush fruits in general. This type of fruit cage is a great advance on its more cumbersome predecessors.

A fruit gatherer which eliminates much ladder work and certainly saves time consists of a string bag attached to a metal ring, which, in turn, is fitted to a pole of suitable length. To operate the gatherer one simply has to place the ring under the fruit, and gently touch it with the inside of the ring to deposit it safely in the bag—without damage. The gatherer may be bought without the handle, thus giving one the opportunity to make use of old rake or hoe handles.

Apple storage has its problems, especially for the small gardener with limited space at his disposal. It is now possible to obtain fruit storage trays which look very much like larger editions of the familiar grocer's egg trays. These trays are made of light-weight, composition material and they are available in two sizes—to hold sixteen or twenty-five fruits. As the fruits are kept quite separate from each other the likelihood of disease spreading from one fruit to another is much lessened and inspection is, of course, very easy. Another good point is that they take up very little space when stored—far less than the conventional wooden racks.

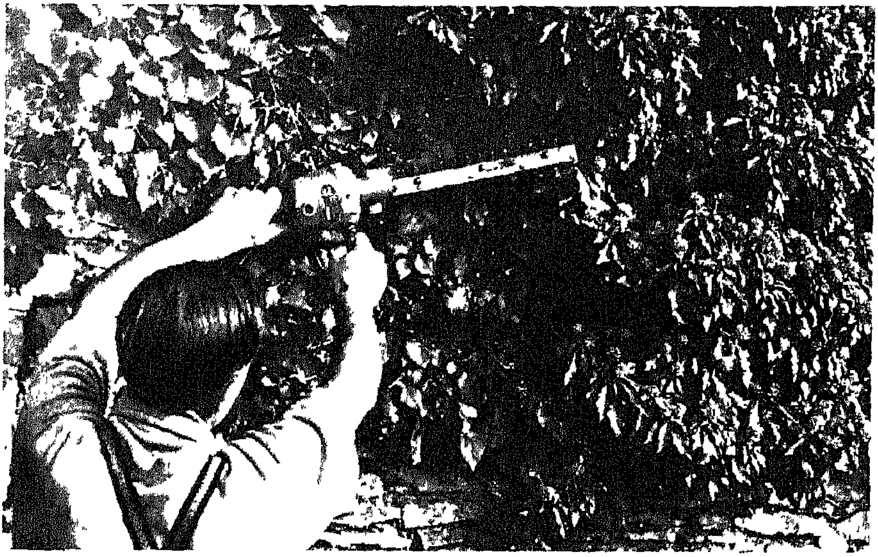
## MULCHING MATERIALS

Most gardeners must by now be well aware of the great advantages to be gained from mulching—the retention of moisture in the soil during long, dry spells and the suppression of weeds. Farmyard manure, compost, spent hops, peat, lawn mowings and straw are all valuable materials for this purpose. Two other materials for mulching which are less well-known are bark fibre and sawdust. Bark fibre was first marketed as a mulching material last year, and it has the advantage of being reasonably cheap. When suitably mature it may also be used for digging into the soil, and pot-grown bulbs raised in this medium give quite spectacular results. Old sawdust is also a useful mulching material; it is when fresh sawdust is used that trouble may result. This is because fresh wood-waste products cause denitrification of the soil through the action of bacteria. American researches into this problem indicated that sawdust and similar wood-waste products should have nitrogen added to bring their nitrogen content up to 1·2 to 1·5 per cent. As an indication of how much is needed, 112 pounds of sulphate of ammonia would be an average dressing for a ton of fresh, dry sawdust. When mulches are used, it is necessary to make regular inspections of the soil underneath them, to ensure that it has not dried out: remember that it lessens the need for, but does not dispense with watering.

While on the subject of soil, there are two other things which must be mentioned: an excellent new type of sieve, and soil blocks, which make conventional clay pots unnecessary. The sieve consists of a container fitted with a wire mesh base, this running along its supporting framework on four wheel bearings. This container has, therefore, only to be moved on its rollers and not lifted as in ordinary sieving, and the operator can sift large quantities of soil without becoming tired. Several types of soil block-making machines are now available, including models especially designed for the amateur gardener. Many plants grow remarkably well in soil blocks, and a great advantage is that the roots receive little disturbance when the plants are set out in the open garden. Soil blocks may be used for rooted plants, cuttings or seeds, and they are easy to make once one has had a little experience in the operation. The most important thing is to get the compost in just the right condition, with neither too much nor too little moisture content.

## HAND CULTIVATORS

A wheeled hand hoe is a useful tool in the garden which is not large enough to need a mechanical cultivator. These cultivators also carry attachments for ploughing, raking and other operations and with fair usage they will last for a very long time. Single and twin-wheeled models are available and they enable the busy gardener to cover a much greater area of ground in a given



ELECTRIC HEDGE TRIMMER

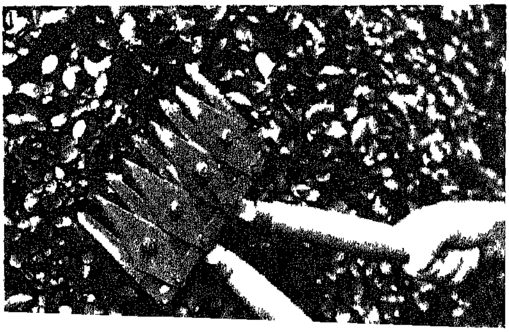
*If more than 40 feet of hedge, 6 feet high, has to be cut, an electric hedge trimmer is an economic proposition. A reciprocal-bladed machine gives a clean, neat cut and does the work ten times faster than hand shears (The Tarpen Engineering Co. Ltd)*

RUST-RESISTANT HAND SHEARS

*If hedges must be cut by hand, a well-designed and well-balanced pair of shears is essential This pair has the advantage of being rust-resistant (The Wilkinson Sword Co Ltd)*

FRUIT PICKER

*There are many fruit-picking machines This one has the merit of costing only a few shillings and makes apple gathering a simple business (E J Woodman & Sons)* ⇨



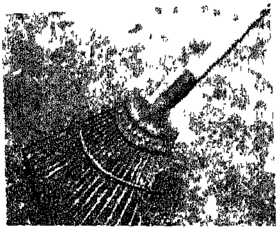
MULTIPLE HAND SHEARS

*the dozen of hand shears*

**LONG-HANDLED SHEARS** *Nothing smartens a garden more than edging the lawns With light, modern long-handled shears, steel-shafted, with rubber grips and rust-resisting blades, the job is a pleasure (The Wilkinson Sword Co Ltd)* ⇨

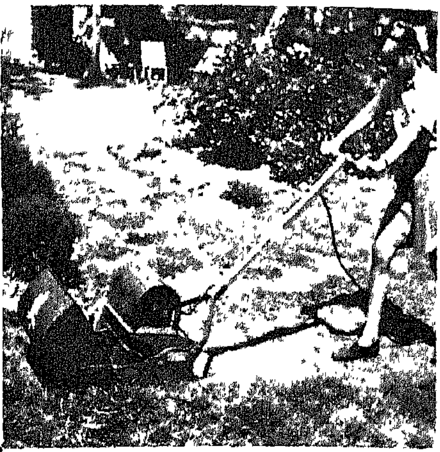
**ELECTRIC EDGE TRIMMER** *Where lawns are extensive and the edges unending, an electric edging tool is a necessity. It trues-up the edge as well as trimming it (The Tarpen Engineering Co. Ltd.)* ⇩

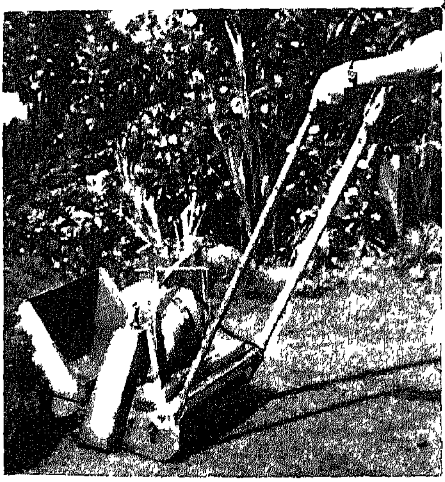
**VERSATILE WIRE RAKE** *The wire rake has many uses in the garden Nowhere is it more happily employed than in teasing out the dead grasses from a neglected lawn* ⇩



ELECTRIC MOWER

*The modern electric mower is a well-designed tool Its weight and balance are such that a schoolgirl can operate it (Alexander Shanks & Son Ltd )*



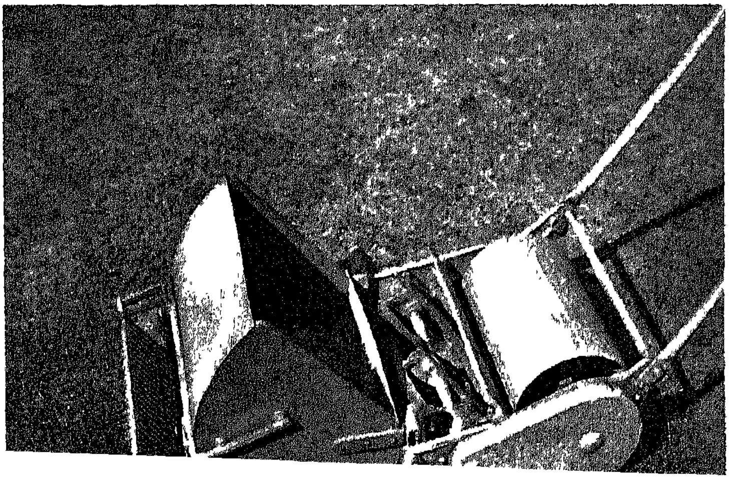


POWER ATTACHMENT

*An ordinary roller-type push-mower may be converted by mounting an electric motor to drive the cutting blades. For half the price of a motor mower one can have more than half its advantages*

TWO OPERATIONS IN ONE

*Removing dead grass and debris from a lawn is essential to the production of fine turf This attachment for hand or motor mowers does it as a routine operation while the mowing is in progress (Mowrake Co Ltd )*

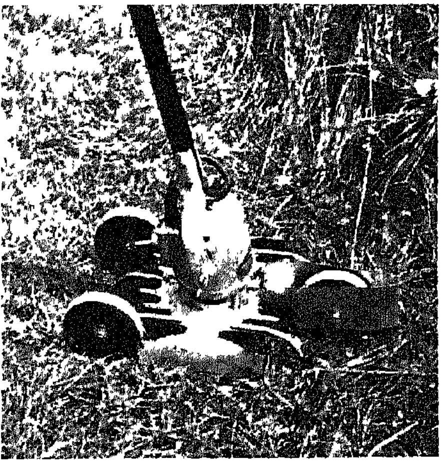


POWER CULTIVATOR

*The cheapest cultivator on the market. It will do all the digging and hoeing needed in the garden of average size (Rotary Hoes Ltd.)* ⇧

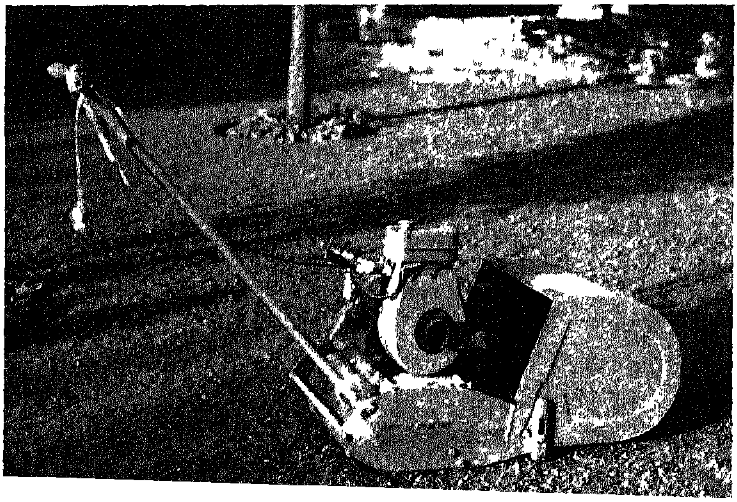
FOR ROUGH GROUND

*Cutting long grass or weeds in awkward places is easy with this electrical tool (The Tarpen Engineering Co. Ltd.)* ⇨



4-STROKE MOTOR MOWER

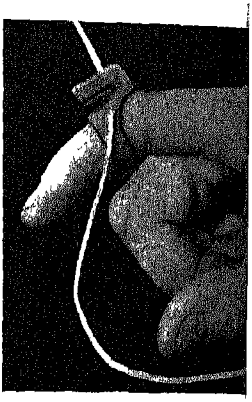
*The most economical four-stroke motor mower yet produced. It is excellent value (Suffolk Iron Foundry Ltd.)* ⇩



TYING AID

*The "string-ring" is a great time-saver A protected blade snips the string or raffia and leaves the hands free for tying (Morgans (Tyseley) Ltd)*

⇩

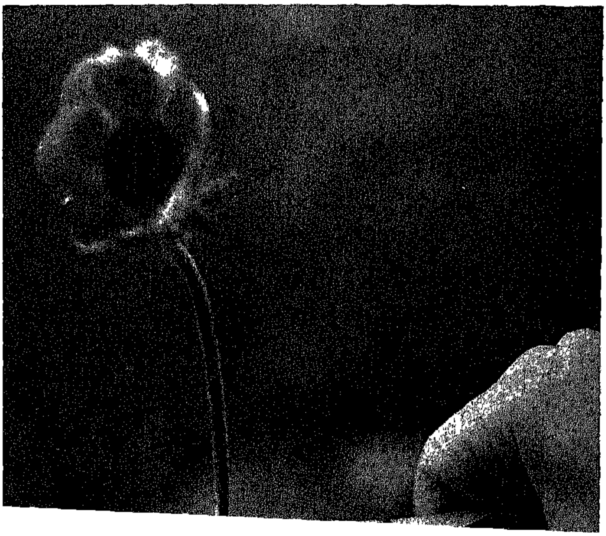


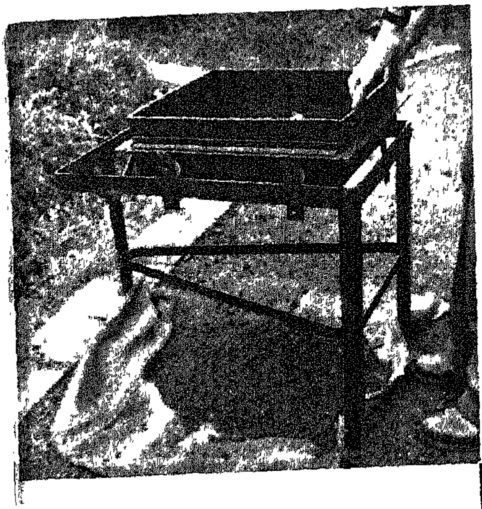
⇧

PRUNING AID

*A hooked pruning saw is a useful tool. It may be hung on a branch, or used to retrieve prunings that have fallen and lodged among the branches (Wm Wood & Son Ltd.)*

FLOWER GATHERER





SOIL SIFTER

*Sifting soil can be very hard on the muscles. This sieve works on rollers and is simplicity to use* ⇦ (Geo. Monro Ltd.)

LIGHT-WEIGHT BARROW

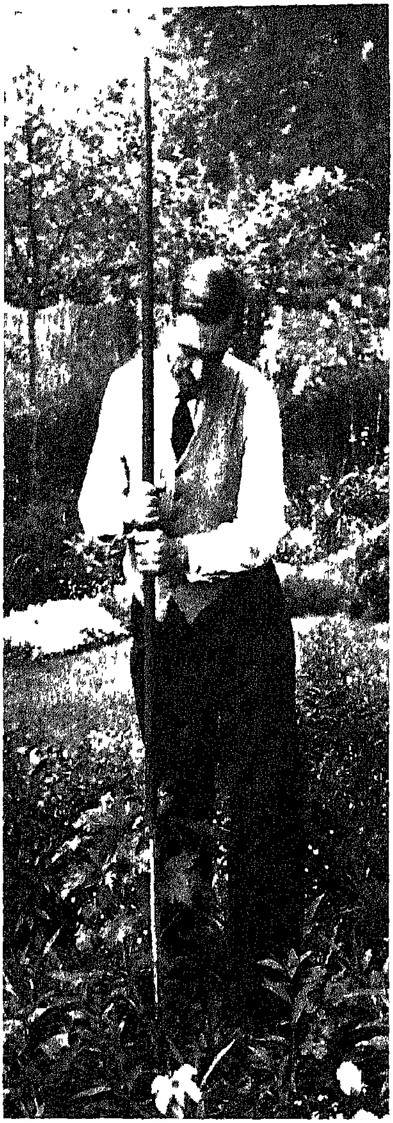
*Although the modern light-weight metal barrow does not hold a great deal, it is a boon for older folk* ⇩

SOIL POTS ⇧

*Soil blocks eliminate the necessity of washing and crocking pots. This is a cheap and effective soil-block maker* (Clico Ltd.)

WEED BURNER

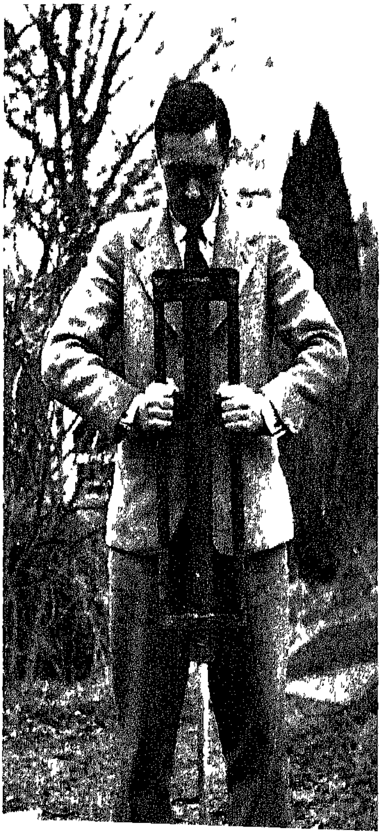
*A flame-thrower, such as the "Hauck" is a formidable weapon*



STAKING AID

*Pushing bamboo canes into hard ground is an unrewarding business This machine does it easily without splitting the canes (Drivall Ltd)*

⇦



POST DRIVING TOOL

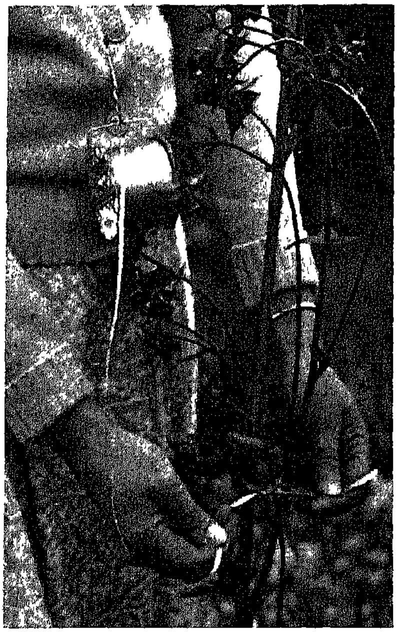
*Posts of any thickness may be driven into the ground without the necessity of pointing them if the right size of driving tool is used (Drivall Ltd)*

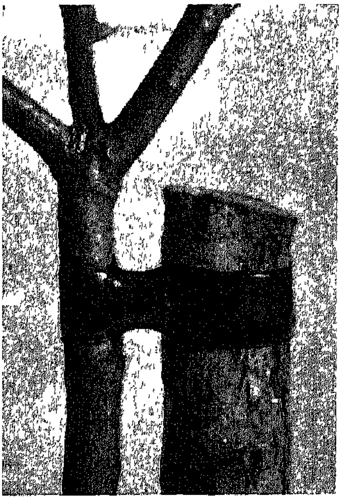
RINGED SUPPORTS

*Wire rings of various sizes save valuable time in giving support to many garden plants*

HAND-FREE TAPE REEL

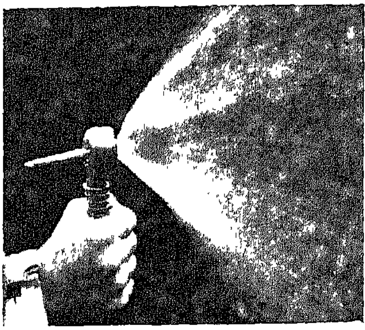
*Horticultural tape on a reel that can be hooked into a button-hole is a great time-saver (P. P. Payne & Sons Ltd.)*





ADJUSTABLE TIES

*The "Calvert" tree support is made of rubberized fabric. It is neat and can be loosened for re-adjustment as the trunk swells (G. R. Byham & Co.)*



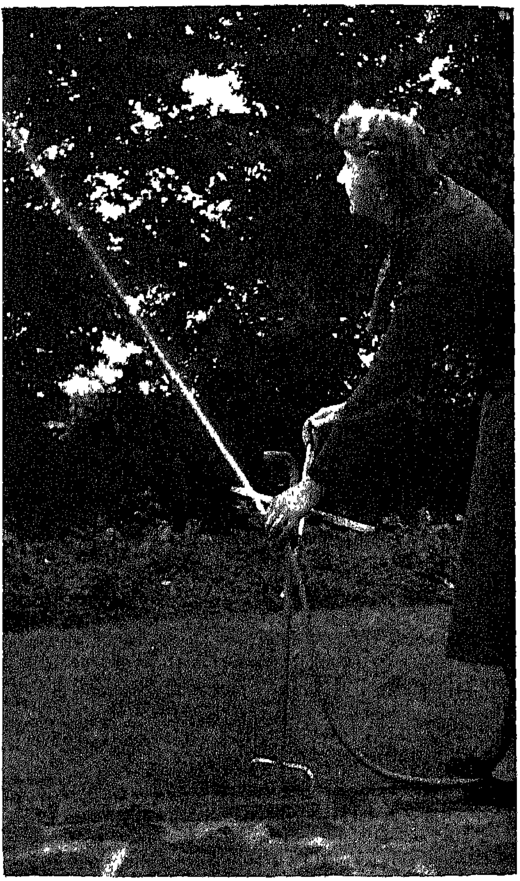
VERSATILE SPRINKLER

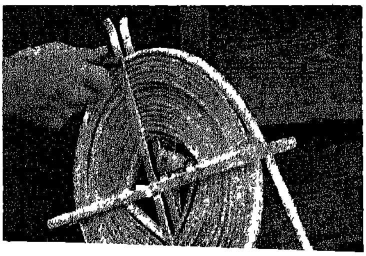
*Costing only five shillings, with no wearing parts, this sprinkler may be stuck in the ground, held in the hand or wedged into a tree or fence (Gilham & Co. Ltd.)*

⇦

SPRAY DIRECTOR

*A "trident" to which a reel is attached may also be used as a stand for the spray nozzle of a hose (Creators Ltd.)* ⇨





HANDY SPRAYER

*A small pint-sized pressure sprayer is useful in the garden and in the greenhouse*

⇧

PRESSURE SPRAY

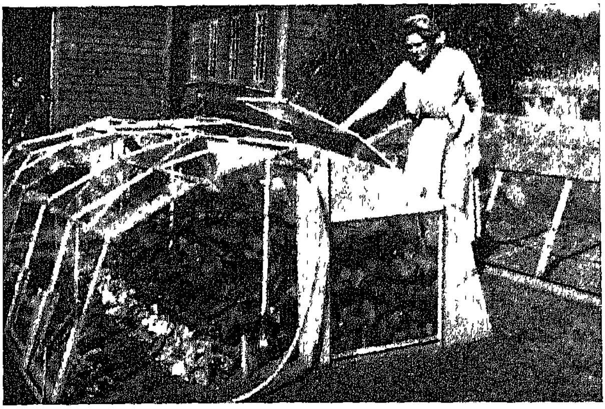
*When spraying must be done, a pressure sprayer, leaving one hand free for turning back the leaves, is a great boon* (Geo. Monro Ltd.)

⇩

TRICKLE HOSE

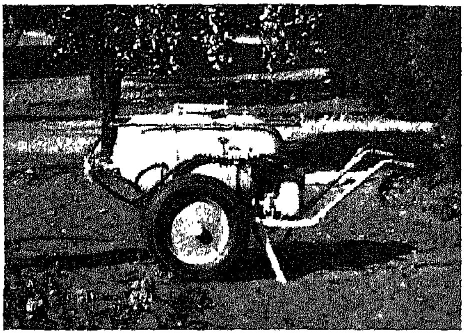
*A "trickle" irrigation line. Plastic nozzles every 18 inches drip a quarter of a pint an hour. The tilth is not beaten down and evaporation losses are negligible (Chase Protected Cultivation)*

⇩

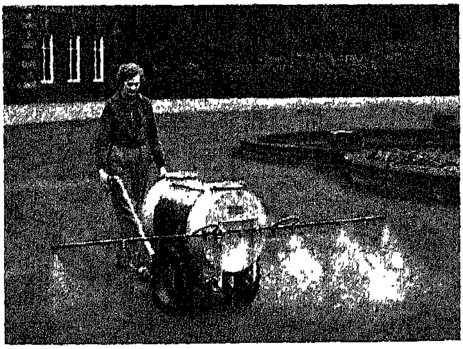


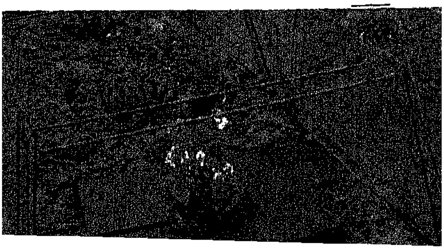
HOSE-FITTED FRAME
*Portable metal frames with a built-in irrigation line may be kept in constant use throughout the year (Lendon (Dorset) Ltd.)*
⇦

LARGE-SCALE SPRAYING
*Where considerable areas are to be sprayed, a power-driven sprayer is essential. Various models are now available (The Four Oaks Spraying Machine Co. Ltd.)* ⇨



JET SPRAYING
*The work of lawn or soil spraying is eased by the use of a jet type of sprayer which covers a wide area in one operation (The Four Oaks Spraying Machine Co. Ltd.)* ⇨





time than would be possible with hand tools. Stainless steel spades and forks have, of course, been with us for a long time now, and can be strongly recommended to those prepared to pay the extra money. In a heavy sticky soil the smooth shining surface of these tools lightens the work and makes them a joy to use.

## ACCESSORIES

All gardeners seem to have strong views about labelling: some detest the sight of labels and keep them to the minimum, while others—myself included—think they are an excellent aid to a by no means infallible memory. Labels are not only useful for recording plant names; they are also valuable for recording sowing or planting dates, the origin of a particular specimen, and other interesting information. Of course, the argument that labels are unsightly *is* valid, if no attempt is made to make them as unobtrusive as possible. But there are labels of so many types and sizes now on the market that choosing the right one for a particular plant is an easy matter. Wooden labels are still widely used, but plastic and metal alloy labels are becoming increasingly popular. The alloy labels, on which one can write with an ordinary pencil or with special ink, are hard to beat, and they have a very long life.

One of the minor frustrations of flower-gathering is holding, say, a bunch of roses with one hand and trying to extract a cut bloom from the centre of the bush with the other. A flower-gatherer which not only cuts the flower but holds it overcomes this problem. Another little tool which I find very useful is a pocket-size pruner, which, although only a few inches long, can do a real job of work, and is, of course, very convenient to carry. In the larger garden, with plenty of standard fruit trees, a long-arm pruner will be found very useful in cutting out much ladder work. Light-weight wheel-barrows with metal bodies are very robust and quite up to doing most jobs in the garden.

Manufacturers of garden tools and equipment are, of course, like all manufacturers, always hoping to produce something more efficient, cheaper and better than their competitors, which is all to our advantage. Some of the tools I have mentioned here may quite soon be superseded by others which do their particular job even more efficiently; on the other hand, there may be some which will still be leading the field for a considerable time yet. This is something, however, which need not concern the gardener overmuch; more demanding of his attention is the matter of reducing overhead expenses. By getting together —over an extended period, if necessary—a range of tools and equipment which will reduce his reliance on expensive casual labour to a minimum, he will have gone far towards achieving that end.

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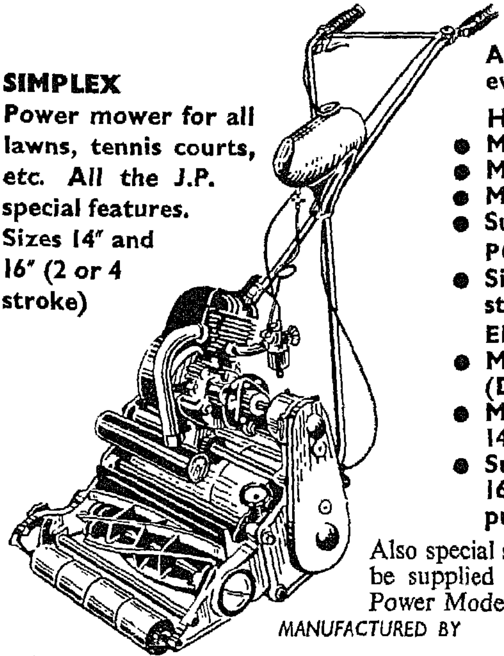

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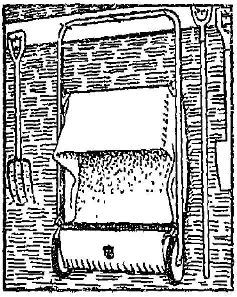

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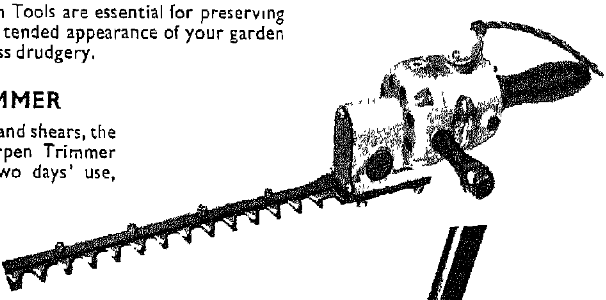

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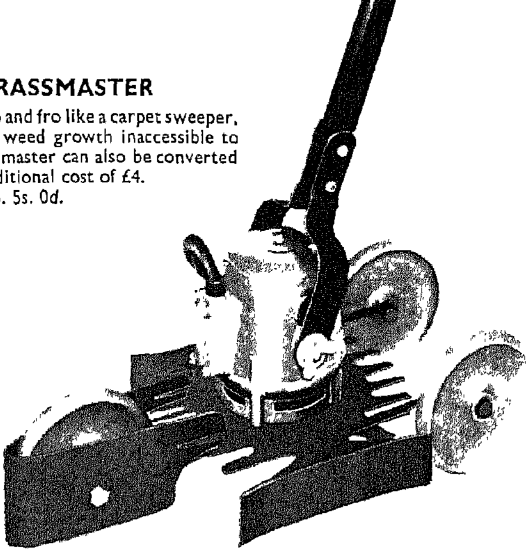

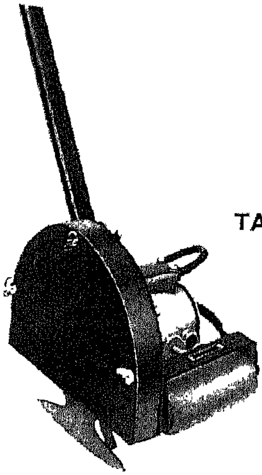

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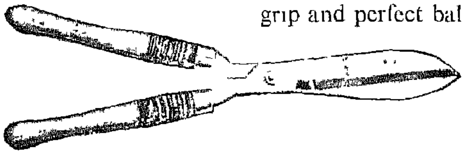

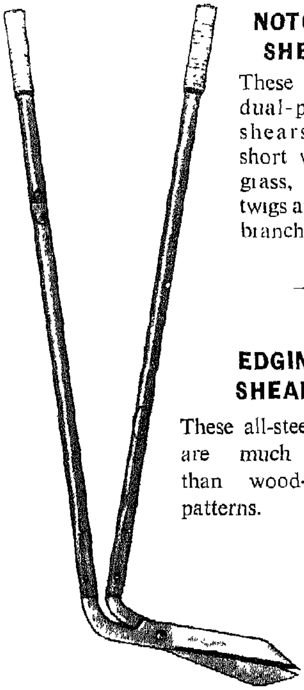

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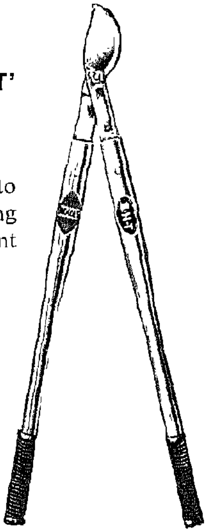

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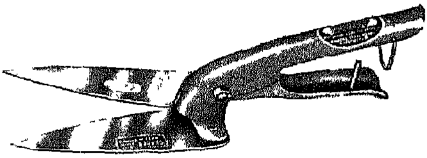

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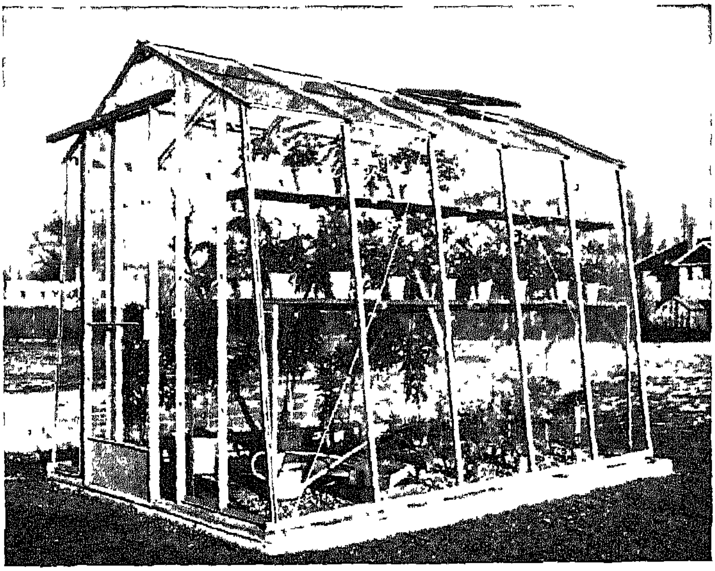

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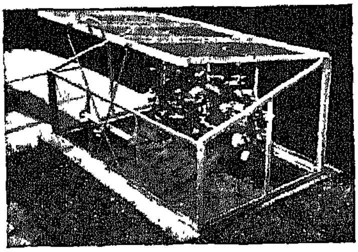

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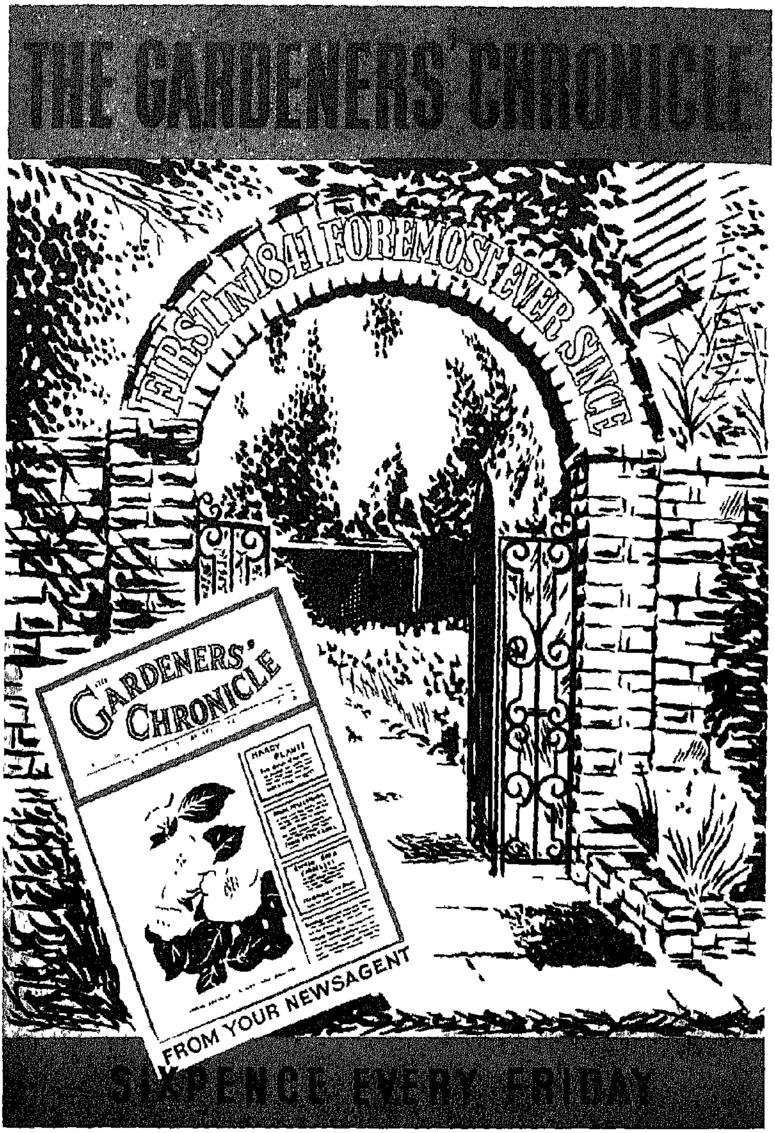

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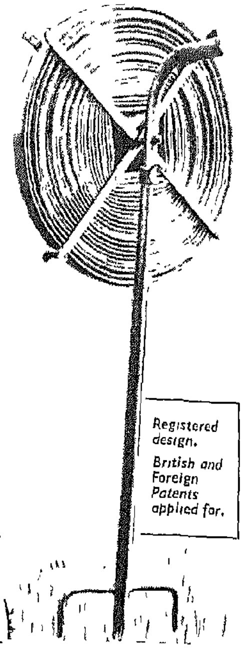

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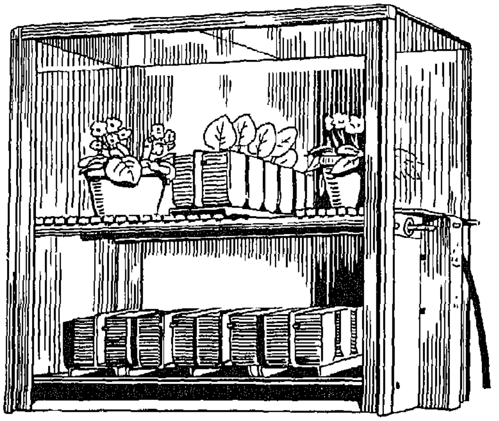

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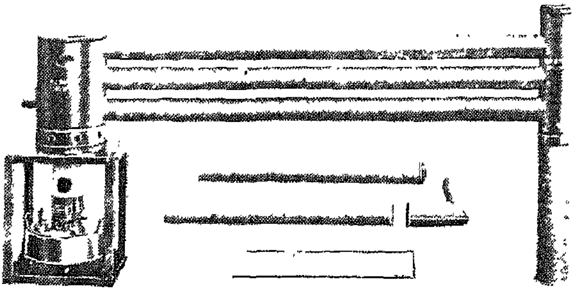

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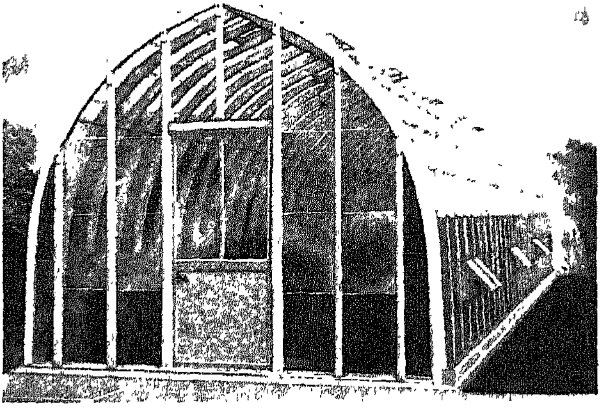

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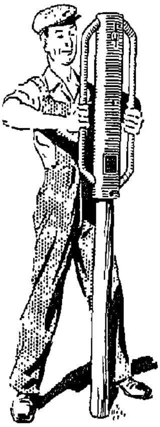

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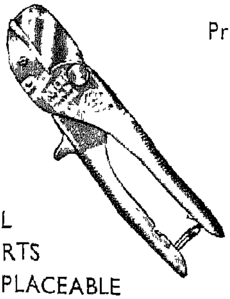

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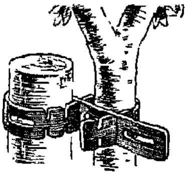

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